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December 20, 2007

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Subject: Work Plan for Amendment 3 of Work Assignment 0-01, EPA Contract EP-C-07-028, under SwRI Project 03.13363, SwRI Proposal No. 03-50782A.

Contract Title: "Testing and Related Support for Energy Bill-Mandated Activities"

Assignment Title: "Comprehensive Gasoline Light Duty Exhaust Fuel Effects Test Program to Cover Multiple Fuel Properties and Two Ambient Test Temperatures"

1.0 INTRODUCTION

Section 1506 of the Energy Policy Act of 2005 (Energy Act) requires EPA to produce an updated fuel effects model representing the 2007 light duty gasoline fleet, including determination of the emissions impacts of increased renewable fuel use.

The use of ethanol in gasoline has increased more than five-fold since 2000, and it is likely that its use will continue to expand into the next decade. It is also likely that use of high-level blends such as E85 will expand significantly.

Additionally, recent investigation related to the Mobile Source Air Toxics (MSAT2) rulemaking has shown that hydrocarbon emissions from light duty gasoline vehicles increase significantly as test temperature is decreased. As a result, the MSAT2 rulemaking promulgated NMHC standards at 20°F. However, this being a relatively new area of study, fuel effects data at temperatures lower than 75°F is scarce for use in emissions models.

Hydrocarbon (HC) emissions are composed of hundreds of compounds, some of which have been identified by the EPA as air toxics. The Clean Air Act directs EPA to set standards to reduce air toxics emissions. Most existing data on the fractional relationship between the various air toxics and HC emissions has been established using vehicles meeting Tier 0 emissions standards (now more than 10 years old), and burning fuels that did not contain ethanol.

In order to help EPA develop a better understanding of the impact of ethanol fuel blends on light duty vehicle emissions, Southwest Research Institute® (SwRI®) will conduct Work Assignment 0-01, "Comprehensive Gasoline Light Duty Exhaust Fuel Effects Test Program to Cover Multiple Fuel Properties and Two Ambient Test Temperatures". SwRI will comply with the requirements of Work Assignment 0-01 as described in the EPA Statement of Work (included in Appendix A), with reservations and exceptions as noted below in Section 8.

2.0 TECHNICAL DISCUSSION

The objective of Work Assignment (WA) 0-01 is to fill significant data gaps on fuel effects for the newest-technology (Tier 2) vehicles follows:

- Multiple levels of ethanol in gasoline will be examined in this test program, along with ethanol's interactions with other fuel properties such as volatility and distillation parameters.
- Varying levels of aromatics will also be evaluated, as they continue to be of interest due to their relationship to emissions of air toxics and the formation of particulate matter in the atmosphere.
- A portion of the tests will be performed at 50°F to fill the gap in the existing data at reduced ambient temperatures.
- Total hydrocarbon (THC), non-methane hydrocarbons (NMHC), non-methane organic gas (NMOG), oxides of nitrogen (NO_X), nitrogen dioxide (NO_2), carbon monoxide (CO), carbon dioxide (CO_2), particulate matter (PM), nitrous oxide (N_2O), ammonia (NH_3) and hydrogen cyanide (HCN) emissions shall be determined from newer (Tier 2) vehicles.
- This program shall also generate speciated volatile organic compound (speciated VOC) data. VOC compounds of interest include C_1 – C_{12} hydrocarbons as well as light alcohols and carbonyls.

This proposal is in response to Amendment 3 to the Performance Work Statement. This proposal supersedes SwRI Proposal No. 03-50782, and includes the following changes in scope:

- The number of fuels tested at 75°F (nominal) is set at 19.
- The number of fuels tested at 50°F has been changed from 4 to 3.
- Nitrous oxide (N_2O), ammonia (NH_3) and hydrogen cyanide (HCN) emissions will be determined during Phase 1 of the project.
- All other optional non-VOC speciation has been eliminated.
- Additional determinations of light alcohols and carbonyls will be conducted

3.0 SCOPE OF WORK

This work assignment requires that SwRI procure 19 suitable test vehicles and 19 test fuels. There are two options for randomizing the test matrix, which will affect the amount of test fuel needed. With Option A duplicate tests on a specific vehicle/fuel combination are conducted back-to-back, while Option B specifies a totally randomized test matrix. Option B requires a higher level of effort and more test fuel than Option A. An additional option includes speciation of VOCs during tests conducted at 50°F. It should be noted that the budget estimate attached to this Work Plan is for the first year of the contract only and assumes that Option A will be conducted. Budgetary cost estimates for options are provided in Section 6.0. Details of the project are presented below.

3.1 Work Plan Development

This document represents the latest version of the Work Plan, taking into account the items modified by Amendment 3 to the Performance Work Statement (Appendix A). It is understood that the work will proceed only upon the selection of a set of options by written technical direction from the WAM/PO.

This document assumes that this program will be conducted using Option A, and can be competed within two calendar years. The detailed cost breakdown attached in Appendix B is for the first year of the contract. It assumes that vehicles and fuels will be available for the start of testing by the end of March 2008. Based on these assumptions, SwRI anticipates being able to conduct approximately 170 tests during the first year of the contract. If these assumptions are incorrect, or if EPA chooses a combination of options other than A, the budget for the first year of the contract will need to be adjusted. Such a situation would also require revision of the overall project schedule and budget.

3.2 Quality Assurance Project Plan and Quality Management Plan (QAPP/QMP)

SwRI will submit a Quality Assurance Project Plan (QAPP) to the EPA Work Assignment Manager for approval. The QAPP will be submitted within five (5) weeks following approval of the Work Plan.

3.3 Vehicle Recruitment

SwRI will lease 19 test vehicles, all equipped with automatic transmissions and two-wheel drive, as listed in Table 1. New vehicles will be leased for a two-year period. It should be noted that the budget for the first year of the contract includes a commitment for the full two years of vehicle leases. Additionally, the attached cost estimate for the first year of the contract assumes the vehicles will not be kept beyond the expiration of the 2-year lease. This will be sufficient to accomplish either Option A or B. The attached budget assumes that vehicle leases will start in January 2008.

All vehicles will meet the requirements specified in Table 1. If model year 2007 vehicles are not available, 2008 model year vehicles will be substituted provided that these vehicles are certified at levels at or below those indicated for the 2007 model year vehicles listed in Table 1. If model year 2008 vehicles are selected, SwRI will submit engine family data to the EPA WAM for confirmation and approval prior to recruiting any vehicles.

TABLE 1. TEST VEHICLES FOR RECRUITMENT

MAKE	YEAR	BRAND	MODEL	ENGINE	FAMILY	T2 BIN	NOTE
GM	2007	Chevrolet	Cobalt/HHR	2.4L I4	7GMXV02.4029	5	
GM	2007	Chevrolet	Impala	3.5L V6	7GMXV03.5052	5	FFV
GM	2007	Buick/GMC/Saturn	Enclave/Acadia/Outlook	3.6L V6	7GMXT03.6151	5	
GM	2007	Chevrolet/GMC	Avalanche	5.3L V8	7GMXT05.3381	4	FFV
Toyota	2007	Toyota	Corolla	1.8L I4	7TYXV01.8BEA	5	
Toyota	2007	Toyota	Camry	2.4L I4	7TYXV02.4BEB	5	
Toyota	2007	Toyota	Sienna	3.3L V6	7TYXT03.3BEM	5	
Toyota	2007	Toyota	Tundra	4.0L V6	7TYXT04.0AEV	5	
Ford	2007	Ford	Focus	2.0L I4	7FMXV02.0VD4	4	
Ford	2007	Ford	500/ Taurus/Freestyle	3.0L V6	7FMXV03.0VED	5	
Ford	2007	Ford/Mercury	Explorer/Mountaineer	4.0L V6	7FMXT04.03DB	4	
Ford	2007	Ford	F150	5.4L V8	7FMXT05.44H2	8	FFV
Chrysler	2007	Dodge	Caliber	2.4L I4	7CRXB0144M80	5	
Chrysler	2007	Dodge/Chrysler	Caravan/Town & Country	3.3L V6	7CRXT03.3NHP	8	FFV
Chrysler	2007	Jeep	Liberty	3.7L V6	7CRXT03.7NE0	5	
Honda	2007	Honda	Civic	1.8L I4	7HNXV01.8MKR	5	
Honda	2007	Honda	Accord	2.4L I4	7HNXV02.4KKC	5	
Honda	2007	Honda	Odyssey	3.5L V6	7HNXT03.5VKR or 7HNXT03.5WKR	5	either family
Nissan	2007	Nissan	Altima	2.5L I4	7NSXV02.5G5A	5	

3.4 Test Lubricants

Engine lubricants will be provided by the EPA per recommendations of a vehicle's manufacturer. SwRI will refer to the owner's manual of each vehicle for the proper lubricant viscosity. Based on the needs of the test program, SwRI will inform EPA of the necessary amounts of lubricant needed in each viscosity grade. These are expected to be 5W-20, 5W-30, and 10W-30. Once SwRI receives the test lubricants from EPA, a 1-quart sample will be collected from each drum of lubricant. All samples will be sent to a laboratory designated by the EPA WAM. After the last test of each vehicle in the program SwRI will measure and record the lubricant level indicated on the dipstick, after which a 1-quart lubricant sample will also be collected. These samples will also be sent to the same laboratory specified by EPA. No provisions for analyses of lubricant samples have been included in this Work Plan. It is understood that EPA will arrange for sample analysis and provide SwRI with the required shipping information prior to the start of the program.

3.5 Test Fuels

SwRI will procure and store all 19 test fuels for this program, as given in Appendix A of the attached Statement of Work. To date, only Haltermann Products has expressed a willingness and ability to provide the test fuels for this program. At this point in time, Haltermann has provided only budgetary estimates for the cost of test fuels. Thus, the actual cost of the test fuels may vary from what is estimated in the attached budget. It should also be noted that the attached budget for the first year of the contract assumes that Option A will be conducted. Based on the anticipated Option A test sequence (given below in Section 3.7.1) SwRI anticipates needing 10 drums of each test fuel. For contingency purposes, this amount includes approximately 50 percent more fuel than will be needed to complete the program. If Option B is chosen the amount of each test fuel needed would be 21 drums, including the 50 percent contingency. If option B is chosen, the additional fuel would need to be procured during the first year of the contract, which would require a revision to the budget. The attached budget assumes that fuels will be delivered, approved, and available for testing by the end of March 2008.

In addition to the fuel amounts listed above, another 200 gallons each of fuels 17, 18, and 19 will be prepared and shipped to EPA's facility in Ann Arbor, Michigan after they have been blended and approved by the WAM.

SwRI has indicated to Haltermann that test fuels will be blended exclusively from refinery components and cuts of refinery components. Special chemicals and chemical blendstocks will not be used. However, butane and benzene may be used to adjust RVP and benzene content of these fuels, respectively. Furthermore, sulfur content of the fuels may be adjusted using a three-component sulfur mixture containing 4.3 mass % of dimethyl disulfide, 22.8 mass % of thiophene and 72.9 mass % of benzothiophene. An oxidation inhibitor will be added to all finished test fuels. Haltermann has indicated that they expect to be able to meet these requirements.

It is understood that all ethanol-containing fuels should be prepared using denatured ethanol meeting the requirements of ASTM D4806 standard. The properties of all ethanol-containing fuels will be reported on a total sample basis (e.g. hydrocarbon type content by ASTM D1319 will be corrected for ethanol content in the fuel). An oxidation inhibitor shall be added to all finished test fuels.

Hand blend inspection data for every test fuel will be presented to the EPA WAM for review. Final blending will not proceed unless authorized by the EPA WAM. Final blend inspection data generated by Haltermann will be forwarded to the EPA WAM for review prior to the shipment of these fuels for use in this test program. The shipment of the fuels to SwRI and their use in this program will not proceed unless authorized by the EPA WAM. Once a fuel has been accepted for testing, a 5 gallon sample shall be shipped to EPA for use in an audit and/or a round robin program.

Once the fuels are received, SwRI will conduct a limited set of analyticals (to be determined) on a single drum sample of each fuel. Additional analyses (to be determined) will be conducted on a single drum sample of each fuel at the midpoint and end of the program to determine whether any fuel properties have changed as a result of fuel storage and handling.

To assure that no drums are mislabeled, fuel properties will be confirmed when each drum is opened using a Petrospec analyzer. Additionally, all drums will be receive a unique alphanumeric label and each time a vehicle is fueled the alphanumeric code will be recorded.

It is understood that test fuel should not be stored outside, and should be maintained in sealed 5B drums at a constant temperature of no more than 75°F (nominal). SwRI currently has capacity to store approximately 40 to 50 drums at 45°F (nominal), and another 75 to 100 drums at room temperature. Based on Option A, SwRI estimates that approximately 190 drums of fuel will be needed for this project. If Option B is chosen, approximately 400 drums of fuel would be needed.

SwRI does not currently have the capacity to store all the test fuels at the requested temperatures. We are currently pursuing efforts to increase our on-site temperature-controlled fuel storage capacity in order to meet the needs of this project. We expect that facilities will be available to handle the amount of fuel needed to conduct Option A. However, at this time we can not yet guarantee the availability of sufficient temperature-controlled storage capacity to meet the needs of this project. For this Work Plan, the budget assumes that SwRI will have the necessary facilities in place by the time the fuel is delivered. If this is not the case, however, the project may incur additional costs in order to accommodate EPA's requested fuel storage conditions.

3.6 Vehicle Preparation

New vehicles will be leased for this program. Upon receipt, vehicles will undergo a thorough inspection. This includes inspection of the engine, transmission, axles, exhaust system and tires, and verification that no OBD2 faults are set. Additionally, vehicle information will be collected and recorded for entry into MSOD data tables, as described in Appendix C of the Statement of Work.

Following the inspection, a single FTP test will be performed on each vehicle using a baseline fuel (to be determined). Phase-level measurements of total hydrocarbon (THC), non-methane hydrocarbon (NMHC), oxides of nitrogen (NO_x), carbon monoxide (CO), particulate matter (PM), and carbon dioxide (CO_2) emissions will be submitted to the EPA WAM for review to determine each vehicle's acceptability as a candidate for the test program. SwRI and EPA agree that there is a low probability of finding a new vehicle that is unacceptable for this program. If such a case were to occur, the project would incur additional costs to remedy the situation. It should be noted that the results of initial FTPs may not reflect stable vehicle operation following 4,000 miles of operation.

Each vehicle approved by the EPA WAM will then undergo initial crankcase oil and oil filter replacements. Oil filters will be procured by SwRI per manufacturer's recommendations. Oil will be drained and replaced with one of the EPA-supplied lubricants per the vehicle manufacturer's viscosity requirements. Following an oil and filter change, each vehicle will be brought up to 4,000 odometer miles to eliminate any engine break-in issues. This will be accomplished by operating the vehicles on mileage accumulation dynamometers over the Standard Road Cycle using a non-oxygenated, commercial, 87 octane gasoline. At a predetermined odometer reading during this accumulation (to be provided by the EPA WAM), the crankcase oil and oil filter will be replaced a second time. The lubricant level in the sump will be allowed to stabilize and its level indicated on the dipstick will be recorded. Mileage accumulation will then resume and continue until an odometer reading of 4,000 miles is attained.

Following mileage accumulation and lubricant conditioning, each new vehicle shall once again undergo thorough inspection of the engine, transmission, axles, exhaust system and tires, and verification that no OBD2 faults are set.

If a vehicle is equipped with traction control, it will be disabled either through an interior disable button or other method (remove power fuse to anti-lock brake system (ABS)), and a placard will be placed in the vehicle indicating the method of disabling traction control if driver input is required.

Chassis dynamometer settings will be derived from target road load coefficients as reported in EPA's on-line Test Car List Data Files. Each vehicle will use the same chassis dyno settings during both 75°F and 50°F tests. Target road load coefficients and subsequently-derived chassis dyno settings will be submitted to the EPA WAM for approval prior to the initiation of testing.

3.7 Vehicle Testing

All vehicles will be tested on all test fuels using the California Unified Cycle (LA92). For this program, the LA92 will be conducted as a three-phase, cold-start test in a manner similar to the FTP, including ambient conditions. All tests on a given vehicle will be conducted using the same 48-inch single roll electric chassis dynamometer. It is expected that a single test site will be used for this entire program. The same driver will be used for all tests on a given vehicle; however, it may be necessary to use more than one driver in the program.

Limited testing will also be conducted at 50°F. SwRI does not currently have these facilities in place, but we are pursuing what we believe to be a viable temporary solution to meet the needs of this project. The cost estimates presented in Section 6.0 of this Work Plan assume that the approach we are pursuing in order to achieve 50ºF capability with a 48-inch chassis dyno will be successful. However, if additional effort is required beyond what is currently anticipated, it could result in additional project costs.

Each vehicle shall be tested at least twice on a given fuel at each test temperature regardless of whether Option A or B is selected. After two tests have been completed and the acquired data have passed all quality control verifications, the need for a third test will be determined by following the variability criteria shown in Table 2. If the ratio of any of the criteria pollutants (CO_2, NO_X, NMHC) on a pair of tests for a given vehicle/fuel/temperature combination exceeds the levels shown in Table 2, a third test will be conducted. If a third test is needed, the EPA WAM will be notified (typically within 24 hours) and the summary data for the test pair in question will be provided. For budgeting purposes, this Work Plan assumes that 5 percent of all test pairs will require a third test. If the actual need to conduct a third test exceeds the 5-percent allocation, the project will incur additional costs.

TABLE 2. VARIABILITY CRITERIA FOR TRIPLICATE TESTING

Dilute Gaseous Emission	Criteria for requiring a third test (composite cycle emissions)
CO_2	Ratio of higher / lower > 1.04
NOx	Ratio of higher / lower > 1.81
NMHC	Ratio of higher / lower > 1.67

Based on historical data from the test site SwRI plans to use for this project, we expect that during tests performed at FTP ambient conditions, intake air temperature and humidity will be maintained at 72.5 ± 2.5°F and 65 ± 15 grains H_2O/lb dry air, respectively. Prior to the initiation of testing at 50F, SwRI will recommend intake air temperature and humidity requirements to be used. These requirements will be submitted to the WAM for approval prior to the start of testing at 50°F.

To accomplish this test program, including the necessary daily vehicle preparation and preconditioning given below in Tables 3 and 4, SwRI anticipates testing six (6) vehicles per day at room temperature and four (4) vehicles per day at 50°F. Tests will be conducted 5 days per week. Testing will be conducted during one shift while vehicle preparation and preconditioning will be conducted during a second shift. We expect that the test cell will be available for 48 weeks in a given 52-week period, resulting in an average test cell throughput of 27 to 28 vehicles per week at room temperature, and 18 or 19 vehicles per week at 50°F. This level of effort will require some overtime from core laboratory staff. An allocation for premium pay, as well as the inclusion of a shift differential, has been included in the attached budget. It may be possible to increase the daily test rate at room temperature; however, this may require additional effort.

The attached budget assumes that SwRI will conduct 114 room-temperature tests and approximately 57 tests at 50°F during the first year of the contract. This is contingent on the test fuels being delivered, approved, and available for testing by the end of March 2008. If the start of testing is delayed beyond the beginning of April 2008, it will not be possible to conduct all 171 tests in the first year of the contract, and a revision to the first-year budget will be necessary.

EPA has requested that two test randomization options be considered:

3.7.1 Option A

Under this Option, SwRI will follow the fuel change and test execution sequence as described in Table 3 below. The order in which the various test fuel and vehicle combinations are to be tested will be randomized. However, replicate tests of a given fuel in a particular vehicle will be done back-to-back. The second replicate will be run in the same way as the first except that only THC, NMHC, NMOG (calculated as given in Section 3.7.6), CO, CO_2, NO_X, NO (for determination of NO_2 by difference), ethanol, and PM emissions will be determined from dilute exhaust samples. If the difference between CO_2, NO_X, or NMHC results in any set of two replicates is greater than the variability criteria listed in Table 2, on the following day a third replicate will be run in the same way as the second. This "back-to-back" testing eliminates the need to repeat additional vehicle preconditioning between each replicate test on a given fuel. A cost estimate for employing this option is given in Section 6.0 below.

TABLE 3. FUEL CHANGE AND TEST EXECUTION SEQUENCE FOR OPTION A

STEP	DESCRIPTION
1	Drain vehicle fuel completely via fuel rail whenever possible
2	Turn vehicle ignition to RUN position for 30 seconds to allow controls to allow fuel level reading to stabilize. Confirm the return of fuel gauge reading to zero
3	Fill fuel tank to 40% with next test fuel in sequence. Fill-up fuel must be at the temperature of the next LA92 test (75 or 50oF)
4	Start vehicle and execute catalyst sulfur removal procedure described in Appendix C of CRC E-60 Program report
5	Drain fuel and refill to 40% with test fuel. Fill-up fuel must be at the temperature of the next LA92 test (75 or 50oF)
6	Start vehicle and drive one LA4 cycle. Allow vehicle to idle in park for 2 minutes before engine shut-down
7	Move vehicle to soak area without starting or driving
8	Park vehicle in soak area at proper temperature (75 or 50oF) for 12-36 hours
9	Move vehicle to test area without starting engine
10	Perform LA92 cycle emissions test
11	Park vehicle in soak area of proper temperature for 12-36 hours
12	Move vehicle to test area without driving
13	Perform LA92 emissions test
14	Determine whether third replicate is necessary, based on data variability criteria (see Table 2)
15	If a third replicate is required, repeat steps 10, 11 and 12
16	If third replicate is not required, return to step 1 and proceed with next fuel in test sequence

3.7.2 Option B

As a contrast to Option A, under this option all exhaust emission tests on a given vehicle, including replicates, will be conducted in a random order (see Table 4). All replicates on a given fuel will be run in the same way as the first emissions test except that only THC, NMHC, NMOG (calculated as given in Section 3.7.6), CO, CO_2, NO_X, NO (for determination of NO_2 by difference), ethanol, and PM emissions will be determined from dilute exhaust samples. If the difference between CO_2, NO_X, or NMHC results in any set of two replicates is greater than the variability criteria listed in Table 2, a third replicate will be run in the same way as the second. This will require more frequent vehicle preconditioning between fuel changes but may result in a more preferable experimental design from a statistical point of view. A separate cost estimate for employing this option is given in Section 6.0 below.

TABLE 4. FUEL CHANGE AND TEST EXECUTION SEQUENCE FOR OPTION B

STEP	DESCRIPTION
1	Drain vehicle fuel completely via fuel rail whenever possible
2	Turn vehicle ignition to RUN position for 30 seconds to allow fuel level reading to stabilize. Confirm the return of fuel gauge reading to zero
3	Fill fuel tank to 40% with next test fuel in sequence. Fill-up fuel must be at the temperature of the next LA92 test (75 or 50°F)
4	Start vehicle and execute catalyst sulfur removal procedure described in Appendix C of CRC E-60 Program report
5	Drain fuel, and refill to approximately 40% with test fuel. Fill-up fuel must be at the temperature of the next LA92 test (75 or 50°F)
6	Start vehicle and drive one LA4 cycle. Allow vehicle to idle in park for 2 minutes before engine shut-down
7	Move vehicle to soak area without starting or driving
8	Park vehicle in soak area at proper temperature (75 or 50°F) for 12-36 hours
9	Move vehicle to test area without starting engine
10	Perform LA92 emissions test
11	Return to Step 1 to prepare for next fuel under the fully randomized test schedule

3.7.3 Test Sequence

The emission test program will be executed in the following sequence:

- Phase 1: Fuels 17, 18 and 19 tested in all vehicles at 75°F
- Phase 2: Fuels 17, 18 and 19 tested in all vehicles at 50°F
- Phase 3: Fuels 1-16 tested in all vehicles at 75°F

It is expected that Phase 1 testing will begin in April 2008. SwRI anticipates being able to complete all of Phase 1 during the first year of the contract.

Following completion of Phase 1, it is expected that approximately two weeks will be needed to prepare for Phase 2 testing at 50°F. Pending successful installation and operation of the equipment necessary to conduct testing at 50°F, SwRI anticipates being able to complete approximately 50 percent of Phase 2 during the first year of the contract. The remainder of Phase 2 will be competed in the second year of the contract.

It is expected that Phase3 will begin approximately two weeks following the completion of Phase 2. Assuming Phases 1 and 2 are completed as expected, SwRI anticipates that Phase 3 testing could be completed in February 2009.

3.7.4 Determination of Phase Level and Continuous Regulated Emissions

Phase-level (bag-by-bag) emissions to be determined and reported for all tests are:

- total hydrocarbons (THC)
- non-methane hydrocarbons (NMHC)
- non-methane organic gases (NMOG) as specified in Section 3.7.6 below
- oxides of nitrogen (NO_x)
- nitrogen dioxide (NO_2) will be determined by the difference of measured NO and NO_x values – expected detection limit approximately 50 ppb
- carbon monoxide (CO)
- carbon dioxide (CO_2)
- particulate matter (PM)
- ethanol

For the first test of each set of replicates, THC, NMHC, CO, CO_2 and NO_X, emissions will also be determined on a continuous basis (1 Hz minimum) from raw "modal" samples at the tailpipe position only. These measurements will be made for all fuels. The Statement of Work indicates that direct measurement of exhaust flow should be used to determine continuous mass emission rates. At this time, SwRI does not have the capacity to use a direct exhaust measurement device for the determination of modal emissions. However, we are purchasing a SEMTECH EFM from Sensors Inc. to be integrated into the test site for direct measurement of exhaust flow. It is expected that this equipment will be installed and verified prior to the initiation of testing in April 2008.

Additionally, available data will be acquired from each vehicle's onboard diagnostic (OBD) system during all emissions tests using a DBK70 data acquisition system. Phase level and total test cycle work measured by the chassis dyno will also be determined and reported.

It is expected that the test facilities for testing will meet the requirements of 40 CFR Part 86 Subpart B and 40 CFR Part 86 Subpart C as they apply to vehicle exhaust emissions testing. It is also expected that THC, NMHC, NO_x, CO, and CO_2, and PM emissions sampling and measurement would be conducted as specified in 40 CFR 1065. It should be noted, however, that the current test cell has not been fully reviewed for Part 1065 compliance. It is compliant to Part 86, Subpart B. If

some aspect of testing will need to be done in variance to Part 1065, SwRI will bring this to the attention of the EPA WAM, and will describe how such a variance might impact the test results. Variances must be approved the EPA WAM before testing may begin.

3.7.5 Speciation of Volatile Organic Compounds

Phase-level (bag-by-bag) speciated VOCs will include C_1-C_{12} hydrocarbons as well as light alcohols, aldehydes, and ketones. Sampling and analysis of C_2-C_{12} hydrocarbons will be conducted in a manner similar to CARB method 1002/1003, "Procedure for the Determination of C_2-C_{12} Hydrocarbons in Automotive Exhaust Samples by Gas Chromatography". Sampling and analysis of carbonyl compounds will be conducted in a manner similar to CARB method 1004, "Determination of Aldehyde and Ketone compounds in Automotive Source Samples by High Performance Liquid Chromatography". Analysis of C_1 – C_4 HC samples will be done within one hour of completion of the emissions test. Subsequent analysis of the additional compounds of interest will be done within 4 hours of emission test completion. The time between sample collection and the start of C_1-C_4 HC analysis will be reported. The VOCs to be analyzed are identified in Appendix D of the Statement of Work.

Sampling and analysis of light alcohols will be accomplished by bubbling exhaust through glass impingers containing deionized water and analyzing samples with a gas chromatograph. Analysis will include the following compounds: methanol, ethanol, isopropanol, n-propanol, and tert-butanol (2-methyl-2-propanol).

In Phases 1 and 3 of the program, VOC speciation will be performed for all 3 test phases of the LA92 cycle, on all fuels (3 fuels in Phase 1 and 16 fuels in Phase 3), for a subset of 3 vehicles (vehicles to be selected by the EPA WAM). This includes all repeat tests, and is outlined graphically in Table 5, below.

TABLE 5. VOC SPECIATION SUMMARY FOR 3 VEHICLES IN PROGRAM PHASES 1 AND 3

LA92 Test Phase (bag)	LA92 Test Repeat		
	Test 1	Test 2	Test 3 (if needed)
Phase 1	C_1-C_{12} Speciation Light Alcohols Carbonyls	C_1-C_{12} Speciation Light Alcohols Carbonyls	C_1-C_{12} Speciation Light Alcohols Carbonyls
Phase 2	C_1-C_{12} Speciation Light Alcohols Carbonyls	C_1-C_{12} Speciation Light Alcohols Carbonyls	C1-C12 Speciation Light Alcohols Carbonyls
Phase 3	C_1-C_{12} Speciation Light Alcohols Carbonyls	C_1-C_{12} Speciation Light Alcohols Carbonyls	C1-C12 Speciation Light Alcohols Carbonyls

VOC speciation for the remaining 16 vehicles will only be conducted on samples from Phase 1 of the LA92 test for all 19 fuels tested at room temperature (3 fuels in Phase 1 and 16 fuels

in Phase 3). This will be performed for only one test on each fuel/vehicle combination - no repeat VOC speciations will be conducted. During all repeat tests conducted on these 16 vehicles in Phases 1 and 3 of the program, only light alcohols and carbonyls will be measured during Phase 1, and no hydrocarbon speciation shall be done. This is outlined graphically in Table 6, below.

TABLE 6. VOC SPECIATION SUMMARY FOR 16 VEHICLES IN PROGRAM PHASES 1 AND 3

LA92 Test Phase (bag)	LA92 Test Repeat		
	Test 1	Test 2	Test 3 (if needed)
Phase 1	C_1-C_{12} Speciation Light Alcohols Carbonyls	Light Alcohols Carbonyls	Light Alcohols Carbonyls
Phase 2	none	none	none
Phase 3	none	none	none

In Phase 2 of this test program, hydrocarbon speciation will not be conducted. However, light alcohols and carbonyls will be determined for all 3 phases of the LA92 test cycle, on all 3 fuels, for a subset of 3 vehicles (vehicles to be selected by the EPA WAM) as shown in Table 7. For the remaining 16 vehicles, only Phase 1 measurement of light alcohols and carbonyls will be conducted on the first tests with each of the 3 test fuels, as shown in Table 8.

TABLE 7. VOC SPECIATION SUMMARY FOR 3 VEHICLES IN PROGRAM PHASE 2

LA92 Test Phase (bag)	LA92 Test Repeat		
	Test 1	Test 2	Test 3 (if needed)
Phase 1	Light Alcohols Carbonyls Optional C_1-C_{12} Speciation	Light Alcohols Carbonyls Optional C_1-C_{12} Speciation	Light Alcohols Carbonyls Optional C_1-C_{12} Speciation
Phase 2	Light Alcohols Carbonyls Optional C_1-C_{12} Speciation	Light Alcohols Carbonyls Optional C_1-C_{12} Speciation	Light Alcohols Carbonyls Optional C_1-C_{12} Speciation
Phase 3	Light Alcohols Carbonyls Optional C_1-C_{12} Speciation	Light Alcohols Carbonyls Optional C_1-C_{12} Speciation	Light Alcohols Carbonyls Optional C_1-C_{12} Speciation

TABLE 8. VOC SPECIATION SUMMARY FOR 16 VEHICLES IN PROGRAM PHASE 2

LA92 Test Phase (bag)	LA92 Test Repeat		
	Test 1	**Test 2**	**Test 3 (if needed)**
Phase 1	Light Alcohols Carbonyls Optional C_1-C_{12} Speciation	Light Alcohols Carbonyls Optional C_1-C_{12} Speciation	Light Alcohols Carbonyls Optional C_1-C_{12} Speciation
Phase 2	none	none	None
Phase 3	none	None	none

As an option, hydrocarbon speciation could be conducted during Phase 2 of this program. In this case, speciation would be conducted for all three phases of the LA92 cycle, on all 3 fuels, for a subset of 3 vehicles. For the remaining 16 vehicles, speciation would be conducted only for Phase 1 of the LA92 cycle, also with all 3 fuels. This would include repeat tests as well, and is analogous to Tables 7 and 8, above, by adding "C_1-C_{12} Speciation" to all "Alcohols and Carbonyls" entries. A cost estimate for this option is provided in Section 6.0.

3.7.6 Determination of NMOG

The CARB procedure for calculating NMHC and NMOG will be followed. Phase-level NMOG will be calculated for all phases where the required measurements are available (i.e. NMHC, carbonyls, and light alcohol measurements are made). In cases where one or more components of the phase-level NMOG calculation is not measured (for example, when carbonyls are not measurement in Phases 2 and 3 of some tests) phase-level NMOG mass emissions will by calculated by assuming the missing measurements are below method detection limits. These phase-level NMOG calculations will then be used to calculate composite weighted NMOG mass emission rates. In all cases, all measured phase-level NMOG components (i.e. each compound quantified) will be reported separately along with the associated FID response factors used in NMOG and NMHC determination.

3.7.7 Continuous Measurements of N_2O, NH_3 and HCN

Continuous and phase-integrated emissions of N_2O, NH_3 and HCN will be measured using Fourier Transform Infrared Spectroscopy (FTIR), only during Phase 1 of the program. These measurements will only be taken during the first test of each fuel/vehicle combination and no repeat measurements will be conducted.

4.0 REPORTING AND DELIVERABLES

4.1 Weekly Reports

SwRI will conduct weekly 30-60 minute telephone conference calls with the WAM or her designate that summarize progress to date. These weekly calls are currently scheduled for Tuesday mornings at 10AM Eastern / 9AM Central. When appropriate, weekly test results in spreadsheet form will be provided to the EPA WAM.

4.2 Monthly Written Progress Reports

SwRI will provide monthly progress reports. Invoices will be provided every four weeks according to the existing contract. The monthly progress reports will include information from the most recent invoice. The reports will track percentages of hours used in each task and whether the project is on schedule. They will explain problems encountered including resolutions and indicate if the schedule or budget is affected.

4.3 Data Files

SwRI will submit the data to EPA in three formats, each format having different levels of post processing and aggregation. The files are nominally:

1. Non-Post processed data files (raw data): These are the native test level data files, usually generated by instrumentation, that have not been post-processed for such purposes as time-series alignment or calculation of continuous emission rates. They will be submitted to EPA as a deliverable for this work assignment and labeled using the following convention:

   'e'<*VehID*>_<*fuelID*>_raw.<*extension*>

   where *VehID* is the unique identifier designated for vehicle, *fuelID* is the unique identifier assigned to each fuel type, and *extension* is the appropriate file extension for the file's data format. Modifications to the specified file-naming convention may be adopted following approval from the EPA Work Assignment Manager.

2. Post processed data files: These are the minimally processed test level data files that will contain the composite, test level, bag level, and 1 Hertz (modal) emission rates in the units specified in 40 CFR Part 86. They will be submitted to EPA as a deliverable for this work assignment and labeled using the following convention:

   'e'<*VehID*>_<*fuelID*>_pst.<*extension*>

   where *VehID* is the unique identifier designated for vehicle, *fuelID* is the unique identifier assigned to each fuel type, and *extension* is the appropriate file extension for the file's data format Modifications to the specified file-naming convention may be adopted following approval from the EPA WAM.

3. SwRI will also deliver Mobile Source Observation Database (MSOD) input data files containing test results and vehicle information using table names, structures, field names and field formats as specified in Appendix C of the Statement of Work. During the program it may be necessary to design and apply new data types, tables and structures. As necessary, such modifications to the data structure would be approved by the EPA WAM.

4.4 Mode of Delivery

SwRI will deliver one set of files to the EPA WAM at the USEPA National Vehicle and Fuel Emissions Laboratory at Ann Arbor, Michigan. Data contained in the MSOD formatted tables will be submitted via a secure method to be approved by the WAM. Under no circumstances will these files be delivered by insecure methods such as electronic mail attachments or First Class Mail.

4.5 Draft Final Report

SwRI will submit a draft final report to EPA within six weeks following the completion of all testing under this Work Assignment.

4.6 Final Report

SwRI will provide a final report incorporating EPA comments, within 30 days of receiving comments from EPA. The report will be in hard copy plus an agreed-upon electronic format such as Microsoft Word or Adobe portable document files (*.pdf).

5.0 STAFF ASSIGNMENTS

The SwRI Work Assignment Manager and Principal Investigator will be Kevin Whitney. Mr. Patrick Merritt will be the alternate Work Assignment Manager and E. Robert Fanick will manage VOC emissions analyses.

6.0 PROJECTED LABOR HOURS AND OTHER DIRECT COSTS

Based on our understanding of Work Assignment 0-01, we project the breakdown of employee utilization by labor category as detailed in Table 9 for the first year of the contract. Complete cost detail for the first year's effort is presented in the attached cost breakdown shown in Appendix B. Estimates for other direct costs are shown in Table 10. Table 11 contains cost estimates for Options A and B, as well as optional hydrocarbon speciation during Phase 2 of the test program.

TABLE 9. PROJECTED LABOR HOURS FOR WORK ASSIGNMENT 0-01; FIRST YEAR OF CONTRACT

LABOR CATEGORY	NUMBER OF HOURS
PL4	Ex. 4 - CBI
PL3	
PL2	
PL1	
Senior Technical	
Technical	
Clerical	
Total	
Total Technical Hours	

TABLE 10. PROJECTED OTHER DIRECT COSTS FOR WORK ASSIGNMENT 0-01; FIRST YEAR OF CONTACT

ITEM	PROJECTED OTHER DIRECT COSTS
24-month vehicle lease for 19 vehicles	Ex. 4 - CBI
Chart paper	
Exhaust pipe, flanges	
Fuel	
Fuel analyses	
GC supplies	
Glassware	
Misc. chemical	
Misc. electrical	
Misc. mechanical	
Nitrogen, zero air	
Particulate filters	
Span gases	
Steel and teflon tubing	
Swedgelock fittings	
Tedlar bags	
Vehicle maintenance sets	
TOTAL	

TABLE 11. BUDGETARY COST ESTIMATE FOR OPTIONS

OPTION	Estimated Cost
Option A	$3,951,610
Option B	$4,275,502
Optional Hydrocarbon Speciation During Phase 2 of the Test Program	$ 114,840

8.0 EXCEPTIONS

Given the constraints of the Work Assignment and the Contract, and to account for some additional technical considerations, SwRI has proposed to make the following exceptions to activities specified in Work Assignment 0-01:

8.1 All vehicles will meet the requirements specified in Table 1; however, it is expected that all vehicle will be 2008 MY. It is anticipated that these vehicles will be at or below the certification levels listed for 2007 MY vehicles. However, SwRI will submit 2008 MY engine families to EPA for confirmation and approval prior to leasing any vehicles.

8.2 The Statement of Work requests that 200 gallons each of fuels 17, 18, and 19 be prepared and shipped to EPA's facility in Ann Arbor, Michigan when directed by the WAM. The fuel will be supplied by Haltermann Products, and SwRI cannot guarantee long-term storage of the fuel at Haltermann's facility at the requested conditions. Therefore, SwRI intends to ship the fuels to EPA after they have been blended and approved by the WAM.

8.3 SwRI does not currently have the capacity to store all the test fuels at the requested temperatures. We are currently pursuing efforts to increase our on-site temperature-controlled fuel storage capacity in order to meet the needs of this project. We expect that facilities will be available to handle the amount of fuel needed to conduct Option A. However, at this time we can not yet guarantee the availability of sufficient temperature-controlled storage capacity to meet the needs of this project. For this Work Plan, the budget assumes that SwRI will have the necessary facilities in place by the time the fuel is delivered. If this is not the case, however, the project may incur additional costs in order to accommodate EPA's requested fuel storage conditions.

8.4 SwRI does not currently have facilities in place for testing at 50ºF, but we are pursuing what we believe to be a viable temporary solution to meet the needs of this project. The cost estimates presented in Section 6.0 of this Work Plan assume that the approach we are pursuing in order to achieve 50ºF capability with a 48-inch chassis dyno will be successful. However, if additional effort is required beyond what is currently anticipated, it could result in additional project costs.

8.5 The Statement of Work specifies that vehicle intake air during room temperature test be maintained 75 ± 2°F for and 75 ± 5 grains H_2O/lb dry air, while during tests performed at 50°F, intake air temperature shall be maintained at 50±2°F. Based on historical data from the test site SwRI plans to use for this project, we expect that during tests performed at FTP ambient conditions,

intake air temperature and humidity will be maintained at 72.5 ± 2.5°F and 65 ± 15 grains H2O/lb dry air, respectively. Prior to the initiation of testing at 50F, SwRI will recommend intake air temperature and humidity requirements to be used. These requirements will be submitted to the WAM for approval prior to the start of testing at 50°F.

Ex. 4 - CBI

8.7 It is expected that the test facilities for testing will meet the requirements of 40 CFR Part 86 Subpart B and 40 CFR Part 86 Subpart C as they apply to vehicle exhaust emissions testing. It is also expected that THC, NMHC, NOx, CO, and CO2, and PM emissions sampling and measurement would be conducted as specified in 40 CFR 1065. It should be noted, however, that the current test cell has not been fully reviewed for Part 1065 compliance. It is compliant to Part 86, Subpart B. If some aspect of testing will need to be done in variance to Part 1065, SwRI will bring this to the attention of the EPA WAM, and will describe how such a variance might impact the test results. Variances must be approved the EPA WAM before testing may begin.

8.8 SwRI will provide prototype electronic data file types for the inspection and approval of the EPA WAM under separate cover.

9.0 SUMMARY

Southwest Research Institute has responded to Work Assignment 0-01 with exceptions as noted in Section 8.0 above. Should any questions of a technical nature arise, please contact Mr. Kevin Whitney at 210-522-5869 or Mr. Patrick Merritt at 210-522-5422. If there are questions regarding cost or contractual issues, please contact Ms. Sherry Twilligear at 210-522-3948. Thank you for this opportunity to be of service.

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APPENDIX A

STATEMENT OF WORK, WORK ASSIGNMENT 0-01, AMENDMENT 3

U.S. ENVIRONMENTAL PROTECTION AGENCY

Performance Work Statement

Contract EP-C-07-018	Work Assignment Number 01 Amendment 3
Issuing Office	Environmental Protection Agency 2000 Traverwood Drive Ann Arbor, MI 48105-2498
Contractor	Southwest Research Institute 6220 Culebra Rd. San Antonio, TX 78228-0510
Title	Comprehensive Gasoline Light Duty Exhaust Fuel Effects Test Program to Cover Multiple Fuel Properties and Two Ambient Test Temperatures

Background

Section 1506 of the Energy Policy Act of 2005 (Energy Act) requires EPA to produce an updated fuel effects model representing the 2007 light duty gasoline fleet, including determination of the emissions impacts of increased renewable fuel use.

The use of ethanol in gasoline has increased more than five-fold since 2000, and it is likely that its use will continue to expand into the next decade. It is also likely that use of ethanol blends at 10% or greater will expand significantly.

Recent investigation related to the Mobile Source Air Toxics (MSAT2) rulemaking has shown that hydrocarbon emissions from light duty gasoline vehicles increase significantly as test temperature is decreased. As a result, the MSAT2 rulemaking promulgated NMHC standards at 20°F. However, this being a relatively new area of study, fuel effects data at temperatures lower than 75°F is scarce for use in emissions models.

Hydrocarbon (HC) emissions are composed of hundreds of compounds, some of which have been identified by the EPA as air toxics. The Clean Air Act directs EPA to set standards to reduce air toxics emissions. Most existing data on the fractional relationship between the various air toxics and HC emissions has been established using vehicles meeting Tier 0 emissions standards (now more than 10 years old), and burning fuels that did not contain ethanol.

Scope and Objectives

This Work Assignment (WA) has been designed to fill significant data gaps on fuel effects for the newest-technology (Tier 2) vehicles:

- Multiple levels of ethanol in gasoline shall be examined in this test program, along with ethanol's interactions with other fuel properties, e.g. volatility and distillation parameters.

- Varying levels of aromatics shall also be evaluated, as they continue to be of interest due to their relationship to emissions of air toxics and the formation of particulate matter in the atmosphere.
- A portion of the tests shall be performed at 50°F to fill the gap in the existing data at reduced ambient temperatures.
- Total hydrocarbon (THC), non-methane hydrocarbons (NMHC), non-methane organic gas (NMOG), oxides of nitrogen (NO_x), nitrogen dioxide (NO_2), carbon monoxide (CO), carbon dioxide (CO_2), particulate matter (PM), nitrous oxide (N_20), ammonia (NH_3) and hydrogen cyanide (HCN) emissions shall be measured in newer (Tier 2) vehicles.
- This program shall also generate speciated volatile organic compound (speciated VOC) data. VOC compounds of interest include C1 – C12 hydrocarbons as well as light alcohols and carbonyls.

The contractor shall perform vehicle preparation and driving tests to generate analytical data on exhaust gas emissions. The contractor shall also generate electronic reports and databases, as well as quality assurance documentation.

Work Requirements

This work assignment requires that the contractor procure 19 suitable test vehicles and 19 test fuels and execute the test program described below.

The contractor shall be responsible for providing engineering, technical, and Quality Assurance (QA) support for this project. Engineering support includes facility design, test plan development, and general oversight of data collection activities. Technical support includes installing and maintaining all instrumentation and support equipment, as well as calibration, testing, and data processing activities. QA support includes reviewing existing standard operating procedures (SOPs), preparing QA documentation, developing miscellaneous operating procedures (MOPs), and reviewing raw and processed data prior to delivery to EPA.

Task 1 Work Plan Development

The contractor shall submit a detailed work plan for EPA approval. The work plan shall include a detailed description of how the tasks described below are to be performed, including details such as toxics measurement methodology. The work plan shall include suggested alternatives for any of the required tests or procedures if such alternatives are thought to result in higher quality results.

This work assignment includes two testing options, A and B, which differ with respect to the degree of test randomization. The work plan costs shall be broken down by task and sub-task for each of these options. The work performed shall be based upon the evaluation of each option presented in the work plan by the EPA Work Assignment Manager (WAM). The work shall proceed only upon the selection of an option by written technical direction from the WAM.

The project work plan shall include descriptions of each task to be accomplished, along with detail on the level of effort, by professional grade, a cost breakdown for each task, and any information on the underlying assumptions used in arriving at these cost estimates. The contractor shall conduct necessary activities to properly and efficiently manage the work assignment, including at least weekly communication with the EPA WAM. The contractor shall also include a list of any facility issues or upgrades that may be needed to implement this work assignment.

This work is projected to cover a period of up to two years. Therefore the work plan must break down costs to indicate what can be reasonably accomplished during this initial contract year.

Task 2 Quality-Assurance Project Plan and Quality Management Plan (QAPP/QMP)

The contractor shall submit a Quality Assurance Project Plan (QAPP) to the EPA Work Assignment Manager for approval. The plan shall detail sample data collection and analysis tasks and procedures for the proposed study. Guidance for QAPP preparation is available at http://www.epa.gov/quality/qapps.html. The QAPP shall be approved by the EPA WAM before any work commences.

The Quality-Assurance Project Plan shall specify the procedures required to collect data in a manner consistent with the objectives of the study. The plan will be developed in consultation with the EPA Work Assignment Manager. The QAPP documents shall conform to the EPA ANSI/ASQC E-4 standard and shall contain appendices containing all applicable standard operating procedures (SOPs).

In the QAPP, the contractor shall describe measures designed to ensure data quality, including but not limited to:

- Standard operating procedures for equipment used to perform calibrations.
- Calibration frequency and schedule for all equipment used in testing (analyzers, dynamometer, chemical speciation equipment).
- Procedures for sampling and recruitment.
- Procedures for data transfer, entry and management.
- Procedures for regular transfer of all data generated in this project to the EPA Work Assignment Manager for review/audit, consistent with Task 7.3 of this Statement of Work.

Task 3 Vehicle Recruitment

The contractor shall acquire (through lease, purchase, or alternate recruitment technique approved by the EPA WAM) 19 test vehicles for use in this program. All of these vehicles must be/have been certified and sold as being compliant with the Federal Tier 2 emissions standards, and shall be selected from the vehicles listed in Table 3-1 . Of these vehicles, 4 must be flexible-fueled vehicles (FFVs) of differing models capable of operation on ethanol-gasoline blends up to and including 85% ethanol (E85). All test vehicles shall be two-wheel drive and feature an automatic transmission. Each vehicle shall have a maximum of 20,000 miles on the odometer (exceptions must be approved by the EPA WAM) at the outset of the emissions test program.

The vehicles shall be in good operating condition with no engine, transmission, or emission system malfunctions indicated or observed.

Table 3-1 lists the target vehicles for recruitment. In cases where multiple vehicle models are listed for a given model year engine family, any model within that family may be selected. If model year 2007 vehicles are not available, 2008 model year vehicles may be substituted provided that these vehicles are of the same certification levels as indicated for the 2007 model year vehicles listed below or cleaner. If model year 2008 vehicles are selected, the contractor shall submit engine family data to the EPA WAM for confirmation and approval prior to recruiting any vehicles.

Table 3-1. Test Vehicles for Recruitment

Make	Year	Brand	Model	Engine	Family	T2 Bin	Note
GM	2007	Chevrolet	Cobalt/HHR	2.4L I4	7GMXV02.4029	5	
GM	2007	Chevrolet	Impala	3.5L V6	7GMXV03.5052	5	FFV
GM	2007	Buick/GMC/Saturn	Enclave/Acadia/Outlook	3.6L V6	7GMXT03.6151	5	
GM	2007	Chevrolet/GMC	Avalanche	5.3L V8	7GMXT05.3381	4	FFV
Toyota	2007	Toyota	Corolla	1.8L I4	7TYXV01.8BEA	5	
Toyota	2007	Toyota	Camry	2.4L I4	7TYXV02.4BEB	5	
Toyota	2007	Toyota	Sienna	3.3L V6	7TYXT03.3BEM	5	
Toyota	2007	Toyota	Tundra	4.0L V6	7TYXT04.0AEV	5	
Ford	2007	Ford	Focus	2.0L I4	7FMXV02.0VD4	4	
Ford	2007	Ford	500/new Taurus/Freestyle	3.0L V6	7FMXV03.0VED	5	
Ford	2007	Ford/Mercury	Explorer/Mountaineer	4.0L V6	7FMXT04.03DB	4	
Ford	2007	Ford	F150	5.4L V8	7FMXT05.44H2	8	FFV
Chrysler	2007	Dodge	Caliber	2.4L I4	7CRXB0144M80	5	
Chrysler	2007	Dodge/Chrysler	Caravan/Town & Country	3.3L V6	7CRXT03.3NHP	8	FFV
Chrysler	2007	Jeep	Liberty	3.7L V6	7CRXT03.7NE0	5	
Honda	2007	Honda	Civic	1.8L I4	7HNXV01.8MKR	5	
Honda	2007	Honda	Accord	2.4L I4	7HNXV02.4KKC	5	
Honda	2007	Honda	Odyssey	3.5L V6	7HNXT03.5VKR	5	either family
					7HNXT03.5WKR		cylinder deact.
Nissan	2007	Nissan	Altima	2.5L I4	7NSXV02.5G5A	5	

All candidate vehicles recruited by the contractor shall be inspected and prepared for testing according to the methodology outlined in Task 5.

Task 4 Test Fuels and Lubricants

Engine lubricants for this program will be provided by the EPA. They will meet the manufacturer's recommended specifications contained in the owner's manuals. The contractor shall inform the EPA WAM of the volume of lubricant needed in each viscosity grade.

At the outset of the program, the contractor shall take a 1 quart lubricant sample from each drum of lubricant supplied and ship all samples to the laboratory designated by the EPA WAM. The contractor shall take an additional 1 quart lubricant sample from each vehicle immediately following its last emissions test in this program and ship the sample to the same laboratory for analysis. EPA will arrange for sample analysis and provide the contractor with the required shipping information prior to the start of the program.

The contractor shall procure and maintain all test fuels for this program. Detailed specification of these fuels is provided in Appendix A.

The test fuels shall be blended exclusively from refinery components and cuts of refinery components. Special chemicals and chemical blendstocks shall not be used. However, butane and benzene may be used to adjust RVP and benzene content of these fuels, respectively. Furthermore, sulfur content of the fuels may be adjusted using a three-component sulfur mixture containing 4.3 mass % dimethyl disulfide, 22.8 mass % thiophene and 72.9 mass % benzothiophene. All blendstocks used in this program must be approved by the EPA WAM.

All ethanol-containing fuels shall be prepared using denatured ethanol meeting the requirements of ASTM D4806 standard. The properties of all ethanol-containing fuels shall be reported on a total sample basis, e.g. hydrocarbon type content by ASTM D1319 shall be corrected for ethanol content in the fuel. An oxidation inhibitor shall be added to all finished test fuels.

Hand blend inspection data for every test fuel shall be presented to the EPA WAM for review. Final blending shall not proceed unless authorized by the EPA WAM. Similarly, final blend inspection data generated by the blending laboratory (in the event that fuel blending will be subcontracted), and by the contractor, shall be forwarded to the EPA WAM for review prior to the shipment of these fuels for use in this test program. The shipment of the fuels to the contractor and their use in this program shall not proceed unless authorized by the EPA WAM. Once a fuel has been accepted for testing, a 5 gallon sample shall be shipped to EPA for use in an audit and/or a round robin program.

The contractor shall make sure that the quantities of test fuels blended include a reasonable safety margin in case some of the tests must be repeated and shall advise the EPA WAM about the magnitude of that margin. In addition, the blending subcontractor (if any) shall prepare 200 gallons (each) of fuels 17, 18, and 19 beyond what is needed for this program. The additional quantities of these fuels shall be shipped to EPA's facility in Ann Arbor, Michigan, when directed by the WAM.

Upon the receipt of test fuels, the contractor shall conduct a limited set of analyses (to be determined) on a single drum sample of each fuel. Additional analyses (to be determined) shall

be conducted on a single drum sample of each fuel at the midpoint and at the end of the program to determine if any fuel properties have changed as a result of fuel storage and handling.

The contractor shall utilize fuel storage and handling practices that will minimize, to the greatest extent possible, any changes in test fuel properties or mislabeling of fuel drums, or any other possible situations which could lead to misfueling of the test vehicles. These practices shall include the storage of test fuels in sealed 5B drums, indoors, at temperatures not exceeding 75°F. Furthermore, to assure that no drums are mislabeled, the contractor shall confirm fuel properties using a Petrospec analyzer each time a new drum is opened. Additionally, unique alphanumeric labels assigned to individual drums shall be recorded each time a vehicle is fueled.

Similarly, the contractor shall ensure that the fuel blending subcontractor (if any) will apply equally stringent fuel storage and handling practices to finished test fuels waiting for shipment. The contractor shall describe the methods to be employed to minimize such changes, and recommend additional methods that would prevent changes in fuel properties during the test program.

Task 5 Vehicle Preparation

Vehicles shall undergo a thorough inspection before beginning the test preparation sequence. This includes inspection of the engine, transmission, axles, exhaust system and tires, and verification that no OBD2 faults are set. The contractor shall collect and record vehicle information described in Appendix C for entry into MSOD data tables.

Following the inspection, a single FTP test shall then be performed using a baseline fuel (TBD) with bag measurements of THC, NMHC, NO_x, CO, and PM emissions. The results of this initial test shall be submitted to the EPA WAM for review to determine the vehicle's acceptability as a candidate vehicle for the test program. If accepted by EPA, an approved candidate vehicle may begin mileage accumulation and/or preparations for testing as outlined below.

Each vehicle approved by the EPA WAM shall then undergo initial crankcase oil, oil filter and air filter replacement. Air filters shall only be replaced in used vehicles (vehicles with more than 4,000 odometer miles). Oil and air filters shall be procured by the contractor per manufacturer's recommendations. One of the EPA-supplied lubricants shall be used per the vehicle manufacturer's viscosity requirements.

If the procured vehicle is used (has more than 4000 miles on the odometer), the engine oil and oil filter shall be replaced a second time following a full engine warm-up. The lubricant level in the sump shall be allowed to stabilize and its level indicated on the dipstick shall be recorded. The vehicle shall then be driven 500 miles on non-oxygenated, commercial, 87 octane gasoline to condition the lubricant in preparation for the emissions test program. Mileage accumulation shall either be done on a chassis dynamometer using the Standard Road Cycle or the vehicle shall be driven primarily on local interstates at or below posted speed limits.

If the procured vehicle is new (less than 4,000 miles), it shall be driven to 4,000 odometer miles either by operating it on a mileage accumulation dynamometer using the Standard Road Cycle or

the vehicle shall be driven primarily on local interstates at or below posted speed limits. The fuel shall be a non-oxygenated, commercial, 87 octane gasoline. At a predetermined odometer reading (to be provided by the EPA WAM), crankcase oil and oil filter shall be replaced a second time. The lubricant level in the sump shall be allowed to stabilize and its level indicated on the dipstick shall be recorded. Mileage accumulation will then resume and continue until odometer reading of 4,000 miles is attained.

After the last test of each vehicle in the program, the contractor shall record the lubricant level indicated on the dipstick before collecting a 1 quart oil sample for analysis as described in Task 4, above.

Following mileage accumulation and lubricant conditioning, each new vehicle shall once again undergo thorough inspection of the engine, transmission, axles, exhaust system and tires, and verification that no OBD2 faults are set. Used vehicles need not undergo this inspection a second time.

If any test vehicle is equipped with traction control, the contractor shall ensure that the latter is disabled either through an interior disable button or other method (remove power fuse to anti-lock brake system (ABS)), and place a placard in the vehicle indicating the method of disabling traction control if driver input is required. The vehicle shall use a 75°F road load horsepower setting derived from the coastdown coefficients as proposed by the contractor and approved by the EPA WAM. For the purpose of this study, the agreed road load setting shall remain the same for all testing on a given vehicle including the cold temperature testing.

Task 6 Vehicle Testing

6.1 Basic Testing Protocol

The basic testing protocol is the testing of the recruited vehicles across all the test fuels over the California Unified Cycle (LA92) as a three phase, cold start test at FTP ambient and load conditions. Limited testing shall also be done at 50°F. All tests on a given vehicle must be done using the same 48-inch single roll (or equivalent) electric chassis dynamometer. More than one such dynamometer may be used in this program. The same driver shall also be used for all tests on a given vehicle (for all test repeats and across all test fuels). The contractor may comment on the feasibility of these requirements and propose additional measures that will reduce test to test variability, such as multi-shift testing on fewer chassis dynamometers.

During tests performed at FTP ambient conditions, intake air temperature and humidity shall be maintained at 75±2°F and 75±5 grains H_2O/lb dry air, respectively. During tests performed at 50°F, intake air temperature shall be maintained at 50±2°F. The contractor shall recommend the intake air humidity setting and tolerance for 50°F emission tests which must be approved by the WAM before 50°F testing can begin.

Option A
The order in which the various test fuel and vehicle combinations are to be tested shall be randomized. However, replicate tests of a given fuel in a particular vehicle shall be done

back-to-back. Specifically, the vehicle shall be tested twice (3 times if determined necessary per emissions variability criteria provided in Table 6.1-3 below) on a given fuel before moving on to the next test fuel in the matrix. This "back-to-back" testing eliminates the need to repeat additional vehicle preps (steps 1-6 of Table 6.1-1, below) between each replicate test on a given fuel.

Option B
As a contrast to Option A, this Option requires the contractor to perform all exhaust emission tests on a given vehicle, even the replicates, in a random order. This will require more frequent vehicle preps between fuel changes but may result in a more preferable experimental design from a statistical point of view.

The emission test program shall be executed in the following sequence:

Phase 1: Fuels 17, 18 and 19 tested in all vehicles at 75°F

Phase 2: Fuels 17, 18 and 19 tested in all vehicles at 50°F

Phase 3: Fuels 1-16 tested in all vehicles at 75°F

The EPA requests that Phase 1 test results be made available as early as possible in the second quarter of 2008. The contractor shall comment on the feasibility of launching and completing Phase 1 of this program in the most expeditious manner.

While it is preferable that Phase 2 of this program be completed immediately following Phase 1, it may also be carried out, as a block, shortly following the launch of Phase 3.

The sequence of events for the testing of an individual vehicle is summarized in Tables 3a and 3b. All vehicles shall be tested two or three times on each fuel at each test temperature (replicate tests). The need for a third test will be determined based on the variability of the previous two replicates (see step 14 in Table 6.1-1, below).

The emissions to be measured and reported are THC, NMHC (by FID), NMOG, NO_x, NO_2, CO, CO_2, ethanol, PM, speciated VOCs, N_2O, NH_3 and HCN. The contractor shall comment on the feasibility and cost of incorporating bag (phase) level measurement of ethanol emissions by means of INNOVA photoacoustic analyzer.

More specifically, the following exhaust emission measurements shall be made:

1. Bag (phase) level and composite THC, NMHC, NMOG, CO, CO_2, NO_x, NO_2, ethanol and PM emissions

2. Bag (phase) level speciated VOCs for a subset of tests (See Task 6.2, below). The list of compounds to be measured and analyzed is given in Appendix D

3. Continuous and integrated by bag (phase) emissions of the following species in raw

exhaust: THC, NMHC, CO, CO_2 and NO_x

4. Continuous and integrated by bag (phase) emissions of the following species measured in raw exhaust for a subset of tests (see Task 6.3.2, below): N_2O, NH_3 and HCN

In addition, the contractor shall report bag (phase) level and total test cycle work measured at the wheels.

The contractor shall acquire all available data from the vehicle's onboard diagnostic (OBD) system during all emissions tests using contractor-supplied data acquisition equipment. The contractor shall comment on the feasibility of this requirement and the capability of the available data acquisition equipment to meet this requirement.

The facilities for testing shall meet the requirements of 40 CFR Part 86 Subpart B and 40 CFR Part 86 Subpart C as they apply to vehicle exhaust testing. THC, NMHC, NMOG, NO_x, NO_2, CO, and CO_2, and PM emissions sampling and measurement shall be conducted as specified in 40 CFR 1065. The minimum detection limit for NO_2, measurements shall be 5 ppb. If some aspect of testing will need to be done in variance to the above specifications the contractor shall describe why that is the case and how it may impact the test results. Variances must be approved the EPA WAM before testing may begin. The methodology to be used for determining NMHC and NMOG emissions is described in the CARB document "California Non-Methane Organic Gas Test Procedures[i]"

The contractor shall recommend sample collection and analytical methods for non-standard emission measurements. These recommendations will take into account analytical detection limits, emission rates expected of Tier 2 vehicles and the requirement to collect all samples in the course of a single LA92 test. All sample collection and analytical methods related to non-standard emission measurements must be approved by the EPA WAM.

6.1.1 Fuel Change and Test Execution Sequence

Option A

Under this Option the contractor shall follow the fuel change and test execution sequence as described in Table 6.1-1, below. The first two emission tests on a given vehicle and fuel combination shall be performed back-to-back. The second replicate shall be run the same way as the first except that only THC, NMHC, NMOG, CO, CO_2, NO_x, NO_2, ethanol (by INNOVA or similar analyzer, if available) and PM emissions shall be measured in dilute exhaust as well as THC, NMHC, CO, CO_2 and NO_x measured continuously in raw exhaust. If the difference between CO_2, NO_x or NMHC results in any set of two replicates is greater than the variability criteria listed in Table 6.1-3, a third replicate shall be run the same way as the second.

Table 6.1-1. Fuel Change and Test Execution Sequence for Option C

Step	Description
1	Drain vehicle fuel completely via fuel rail whenever possible
2	Turn vehicle ignition to RUN position for 30 seconds to allow controls to allow fuel level reading to stabilize. Confirm the return of fuel gauge reading to zero
3	Fill fuel tank to 40% with next test fuel in sequence. Fill-up fuel must be at the temperature of the next LA92 test (75 or 50°F)
4	Start vehicle and execute catalyst sulfur removal procedure described in Appendix C of CRC E-60 Program report
5	Drain fuel and refill to 40% with test fuel. Fill-up fuel must be at the temperature of the next LA92 test (75 or 50°F)
6	Start vehicle and drive one LA4 cycle. Allow vehicle to idle in park for 2 minutes before engine shut-down
7	Move vehicle to soak area without starting or driving
8	Park vehicle in soak area at proper temperature (75 or 50°F) for 12-36 hours
9	Move vehicle to test area without starting engine
10	Perform LA92 cycle emissions test
11	Park vehicle in soak area of proper temperature for 12-36 hours
12	Move vehicle to test area without driving
13	Perform LA92 emissions test
14	Determine whether third replicate is necessary, based on data variability criteria (see Table 6.1-3 below)
15	If a third replicate is required, repeat steps 10, 11 and 12
16	If third replicate is not required, return to step 1 and proceed with next fuel in test sequence

Option B

Under this Option all emissions tests, including replicate tests shall be fully randomized, as described in Table 6.1-2 below. All replicates on a given fuel shall be run the same way as the first emissions test except that only THC, NMHC, NMOG, CO, CO_2, NO_x, NO_2, ethanol (by INNOVA or similar analyzer, if available) and PM emissions shall be measured in dilute exhaust as well as THC, NMHC, CO, CO_2 and NO_x continuously in raw exhaust. If the first two emission tests performed on a given fuel do not meet the variability criteria listed in Table 6.1-3, a third replicate shall be run the same way as the second.

Table 6.1-2. Fuel Change and Test Execution Sequence for Option D

Step	Description
1	Drain vehicle fuel completely via fuel rail whenever possible
2	Turn vehicle ignition to RUN position for 30 seconds to allow fuel level reading to stabilize. Confirm the return of fuel gauge reading to zero
3	Fill fuel tank to 40% with next test fuel in sequence. Fill-up fuel must be at the temperature of the next LA92 test (75 or 50°F)
4	Start vehicle and execute catalyst sulfur removal procedure described in Appendix C of CRC E-60 Program report
5	Drain fuel, and refill to approximately 40% with test fuel. Fill-up fuel must be at the temperature of the next LA92 test (75 or 50°F)
6	Start vehicle and drive one LA4 cycle. Allow vehicle to idle in park for 2 minutes before engine shut-down
7	Move vehicle to soak area without starting or driving
8	Park vehicle in soak area at proper temperature (75 or 50°F) for 12-36 hours
9	Move vehicle to test area without starting engine
10	Perform LA92 emissions test
11	Return to step 1 to prepare for next fuel under the fully randomized test schedule

Each vehicle shall be tested at least twice on a given fuel regardless of option selection. After two tests have been completed and the acquired data has passed all quality control verifications as described in the contractor's QAPP, the need for a third test shall be determined by following the variability criteria shown in Table 6.1-3:

Table 6.1-3. Variability Criteria for Triplicate Testing

Dilute Gaseous Emission	Criteria for requiring a third test (composite cycle emissions)
CO_2	Ratio of higher / lower > 1.04
NOx	Ratio of higher / lower > 1.81
NMHC	Ratio of higher / lower > 1.67

If the ratio of any of the above pollutants on a pair of tests on a given vehicle and fuel combination exceeds the levels shown in Table 6.1-3, the contractor shall proceed with the third test and promptly notify the EPA WAM, making available the electronic summary reports of the tests in question.

6.2 Speciation of Volatile Organic Compounds (VOCs)

VOC speciation shall include C1-C12 hydrocarbons as well as light alcohols, and carbonyls. Sampling and analysis of C2-C12 hydrocarbons will be done using CARB method 1002/1003, "Procedure for the Determination of C2-C12 Hydrocarbons in Automotive Exhaust Samples by Gas Chromatography". Sampling and analysis of carbonyl compounds will be done using CARB method 1004, "Determination of Aldehyde and Ketone compounds in Automotive Source Samples by High Performance Liquid Chromatography". Analysis of C1 – C4 HC samples shall be done within one hour of completion of the emissions test. Subsequent analysis of the additional compounds of interest shall be done within 4 hours of emission test completion. The time between sample collection and the start of C1-C4 HC analysis shall be reported. The VOCs to be analyzed are identified in Appendix D. The contractor shall comment on the feasibility of these requirements and propose additional measures to improve the precision of VOC speciation. All methods used in the measurement of VOCs must be approved by EPA WAM.

In Phases 1 and 3 of the program, VOC speciation shall be performed for all 3 test phases of the LA92 cycle, on all fuels (3 fuels in Phase 1 and 16 fuels in Phase 3), for a subset of 3 vehicles (vehicles to be selected by the EPA WAM). This includes all repeat tests, and is outlined graphically in Table 6.2-1, below.

Table 6.2-1: VOC Speciation Summary for 3 Vehicles in Program Phases 1 and 3

	LA92 Test Repeat		
LA92 Test Phase (bag)	**1**	**2**	**3**
1	C1-C12 Speciation Alcohols Carbonyls	C1-C12 Speciation Alcohols Carbonyls	C1-C12 Speciation Alcohols Carbonyls
2	C1-C12 Speciation Alcohols Carbonyls	C1-C12 Speciation Alcohols Carbonyls	C1-C12 Speciation Alcohols Carbonyls
3	C1-C12 Speciation Alcohols Carbonyls	C1-C12 Speciation Alcohols Carbonyls	C1-C12 Speciation Alcohols Carbonyls

The remaining 16 vehicles shall only require VOC speciation in phase 1 of the LA92 test, also for all test fuels (3 fuels in Phase 1 and 16 fuels in Phase 3). This shall be performed for only one test on each fuel/vehicle combination - no repeat VOC speciations are required. During all repeat tests conducted on these 16 vehicles in Phases 1 and 3 of the program only light alcohols and carbonyls shall be measured and no hydrocarbon speciation shall be done. This is outlined graphically in Table 6.2-2, below.

Table 6.2-2: VOC Speciation Summary for 16 Vehicles in Program Phases 1 and 3

	LA92 Test Repeat		
LA92 Test Phase (bag)	**1**	**2**	**3**
1	C1-C12 Speciation Alcohols Carbonyls	Alcohols Carbonyls	Alcohols Carbonyls
2	none	none	none
3	none	none	none

In Phase 2 of this test program, hydrocarbon speciation shall not be done. Hovewer, light alcohols and carbonyls shall be measured in all 3 phases of the LA92 test cycle, on all 3 fuels, for a subset of 3 vehicles (vehicles to be selected by the EPA WAM). The remaining 16 vehicles shall only require the measurement of light alcohols and carbonyls in phase 1 of the LA92 cycle, also on all 3 test fuels. This shall be done for all repeat tests in Phase 2. The VOC speciation summary for Phase 2 of the program is outlined in Tables 6.2-3 and 6.2-4, below.

Table 6.2-3: VOC Speciation Summary for 3 Vehicles in Program Phase 2

	LA92 Test Repeat		
LA92 Test Phase (bag)	**1**	**2**	**3**
1	Alcohols Carbonyls	Alcohols Carbonyls	Alcohols Carbonyls
2	Alcohols Carbonyls	Alcohols Carbonyls	Alcohols Carbonyls
3	Alcohols Carbonyls	Alcohols Carbonyls	Alcohols Carbonyls

Table 6.2-4: VOC Speciation Summary for 16 Vehicles in Program Phase 2

	LA92 Test Repeat		
LA92 Test Phase (bag)	**1**	**2**	**3**
1	Alcohols Carbonyls	Alcohols Carbonyls	Alcohols Carbonyls
2	none	none	none
3	none	none	none

The contractor shall also provide a separate cost estimate for performing hydrocarbon speciation in Phase 2 of this program for all three phases of the LA92 cycle, on all 3 fuels, for a subset of 3

vehicles, and only in phase 1 of the LA92 cycle for the remaining 16 vehicles, also for all 3 fuels. This would include repeat tests as well, and is analogous to Tables 6.2-3 and 6.2-4, above, by adding "C1-C12 Speciation" to all "Alcohols and Carbonyls" entries.

.The CARB procedure for calculating NMHC and NMOG (mentioned above and referenced at the end of this document) shall be followed. Phase-level NMOG shall be calculated for all phases where the required measurements are available (i.e. NMHC, carbonyls, and light alcohol measurements are made). In cases where one or more components of the phase-level NMOG calculation is not measured (for example, when carbonyls are not measurement in phases 2 and 3 of some tests) the contractor shall calculate phase-level NMOG mass emissions assuming the missing measurements are below method detection limits. These phase-level NMOG calculations shall then be used to calculate composite weighted NMOG mass emissions. In all cases, the contractor shall report all measured phase-level NMOG components (i.e. each compound quantified) separately along with the associated FID response factors used in NMOG and NMHC determination.

6.3 Continuous Measurements of Gaseous Emissions in Raw Exhaust

6.3.1 Continuous THC, NMHC, CO, CO_2 and NO_x

Continuous and integrated by bag (phase) emissions of THC, NMHC, CO, CO_2 and NO_x shall be measured in raw exhaust. The continuous measurements shall be made at a minimum sampling frequency of 1 Hz. A direct raw exhaust flow measurement device, such as SEMTECH EFM made by Sensors Inc. (or equivalent), shall be used. The contractor shall comment on the availability of test cells with this capability and propose methods for continuous raw emissions data alignment. The contractor shall provide sample test data illustrating the agreement between the CVS and raw exhaust measurements of THC, CO, NO_x and CO_2 achievable in their laboratory using Tier 2 vehicles, including an assessment of measurement uncertainty for each method.

These measurements shall be performed during the first test of each fuel/vehicle combination in Phases 1, 2 and 3 of the test program. No repeat measurements are required.

6.3.2 Continuous N_2O, NH_3 and HCN

Continuous and integrated by bag (phase) emissions of N_2O, NH_3 and HCN shall be measured using Fourier Transform Infrared Spectroscopy (FTIR) or an alternate method proposed by the contractor and approved by the EPA WAM.

The measurements of N_2O, NH_3 and HCN emissions shall only be done in Phase 1 of the program, during the first test of each fuel/vehicle combination. No repeat measurements are required.

Task 7 Deliverables

7.1 Weekly Reports

The contractor shall provide 30-60 minute telephone conference reports weekly that summarize progress to date. Weekly test results in spreadsheet form shall be provided to the EPA WAM.

The oral report shall indicate progress achieved in the preceding week, technical issues encountered, solutions to issues (proposed or attempted), and projected activity in the following week. This report shall include any potential issues or circumstances that arise causing any delays in the testing. The WAM or his/her designated alternate shall participate in these phone conferences.

7.2 Monthly Written Progress Reports

The contractor shall provide monthly progress reports with invoices. The reports shall track percentages of hours used in each task and whether the project is on schedule. The contractor shall explain problems encountered including resolutions and indicate if the schedule or budget was compromised.

The reports shall summarize the progress made during the reporting month, technical issues encountered, solutions to issues (proposed or attempted), and projected activity in the following month. Graphical presentations shall be made to display results if data has been collected.

7.3 Data Files

The contractor shall submit the data to EPA in three formats, each format having different levels of post processing and aggregation. The files are nominally:

4. Non-Post processed data files (raw data): These are the native test level data files, usually generated by instrumentation, that have not been post-processed for such purposes as time-series alignment or calculation of continuous emission rates. They shall be submitted to EPA as a deliverable for this work assignment and labeled using the following convention:

   'e'<*VehID*>_<*fuelID*>_raw.<*extension*>

   where *VehID* is the unique identifier designated for vehicle, *fuelID* is the unique identifier assigned to each fuel type, and *extension* is the appropriate file extension for the file's data format. Modifications to the specified file-naming convention may be adopted following approval from the EPA Work Assignment Manager.

5. Post processed data files: These are the minimally processed test level data files that will contain the composite, test level, bag level, and 1 Hertz (modal) emission rates in the units specified in 40 CFR Part 86. They shall be submitted to EPA as a deliverable for this work assignment and labeled using the following convention:

'e'<*VehID*>_<*fuelID*>_pst.<*extension*>

where *VehID* is the unique identifier designated for vehicle, *fuelID* is the unique identifier assigned to each fuel type, and *extension* is the appropriate file extension for the file's data format Modifications to the specified file-naming convention may be adopted following approval from the EPA WAM.

6. The contractor shall also deliver Mobile Source Observation Database (MSOD) input data files containing test results and vehicle information using table names, structures, field names and field formats as specified in Appendix C. During the program it may be necessary to design and apply new data types, tables and structures. As necessary, such modifications to the data structure may be proposed by the contractor and approved by the EPA WAM. The contractor shall inform the EPA WAM if they believe the specified precision for a given field(s) is inadequate or inappropriate. The WAM and the contractor shall then determine what changes in the format may be necessary to accurately store the data for future use in MSOD.

The contractor shall include in the work plan prototype electronic versions of the above three file types for the inspection and approval of the EPA WAM.

7.4 Mode of Delivery

The contractor shall deliver one set of files to the EPA WAM at the USEPA National Vehicle and Fuel Emissions Laboratory at Ann Arbor, Michigan.

The contractor shall deliver the data contained in the MSOD formatted tables via a secure method to be proposed by the contractor and approved by the WAM. Under no circumstances shall the contractor deliver these files by insecure methods such as electronic mail attachments or First Class Mail.

7.5 Draft Final Report

The contractor shall develop a draft final report that details the work completed including any issues encountered and results from Tasks 1 through 7.

The draft report shall be submitted to EPA that includes:

1) Recruitment procedures
2) Vehicle-related information, VIN, mileage, emission system descriptions, etc.
3) Measurement methodologies and quality measures
4) Test completion diary for individual vehicles detailing any relevant information regarding completion of each test
5) All data collected in Tasks 1 through 7 of this work assignment. Graphical displays summarizing the data by fuel type and other relevant breakdowns

The draft final report shall be delivered to EPA within six weeks of the testing completion.

7.6 Final Report

The contractor shall provide a final report incorporating EPA comments, within 30 days of receiving comments from EPA. The report shall be in hard copy plus an agreed-upon electronic format. Microsoft Word or Adobe portable document files (*.pdf) are acceptable formats.

Schedule of Deliverables

Steps	Duration	Completion Date
Conference call to address outstanding issues	As required	December 18, 2007
Project work plan submission	2 weeks	December 18, 2007
EPA reviews and approves work plan	1 week	December 21, 2007
Draft QAPP		January 23, 2008
EPA reviews and approves draft QAPP		February 6, 2008
Vehicle Recruitment	as required for test schedule sequence	
Vehicles accepted by EPA shall begin testing on a rolling basis		First week April 2008
Fuel Acquisition	as required for test schedule sequence	
324 vehicle tests completed, end of current work assignment		June 21, 2008
All Emissions Testing Completed for Test Program	33 weeks (assume April 1rst test start date)	November, 2008
Data Delivery	Ongoing as tests completed (incl. replicates)	December 19, 2008
3 versions of formatted data for each veh/fuel ID	5 working days	
Draft Report		January 1, 2009
Final Report	30 days after EPA comments	March 2009

Work Assignment Manager (WAM)	Constance Hart, 734/ 214-4340
Alternate WAM	Carl Scarbro, ASD 734/214-4209
Technical Contacts	Aron Butler, ASD 734/214-4011 Michael Christianson, ASD 734/214-4624 Antonio Fernandez, ASD 734/214-4431 Rafal Sobotowski, ASD 734/214-4228

Appendix A: Test Fuel Specification

PROPERTY	UNIT	METHOD	BLENDING TOLERANCE	TEST FUELS																		
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Relative Density, 60/60°F	-	D4052	NA	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report
API Gravity, 60°F	°API	D4052	NA	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report
Ethanol Content	**vol. %**	**D5599**	**E0: < 0.1; E10: ± 0.5; E15: ± 0.5**	**0**	**0**	**10**	**0**	**0**	**10**	**0**	**10**	**10**	**0**	**10**	**10**	**0**	**10**	**0**	**10**	0	9.5	14.5
Total Content of Oxygenates Other than Ethanol	vol. %	D5599	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.15
T10	°F	D86	± 10	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140
T50	**°F**	**D86**	**± 4**	**195**	**195**	**195**	**195**	**195**	**195**	**215**	**215**	**215**	**215**	**215**	**215**	**235**	**235**	**235**	**235**	**215**	**202**	**195**
T90	**°F**	**D86**	**± 5**	**300**	**300**	**300**	**350**	**350**	**350**	**300**	**300**	**300**	**350**	**350**	**350**	**300**	**300**	**350**	**350**	**325**	**325**	**325**
FBP	°F	D86	-	<437	<437	<437	<437	<437	<437	<437	<437	<437	<437	<437	<437	<437	<437	<437	<437	<437	<437	<437
DVPE	**psi**	**D5191**	**± 0.15**	**9.0**	**9.0**	**6.65**	**6.65**	**6.65**	**9.0**	**6.65**	**9.0**	**9.0**	**9.0**	**6.65**	**6.65**	**6.65**	**6.65**	**9.0**	**9.0**	**8.85**	**8.85**	**8.85**
Aromatics	**vol. %**	**D1319**	**± 1.5**	**15**	**40**	**40**	**15**	**40**	**15**	**15**	**15**	**40**	**40**	**40**	**15**	**40**	**15**	**15**	**40**	**29.5**	**24.9**	**22.6**
Olefins	vol. %	D1319	± 1.5	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Benzene	vol. %	D3606	± 0.15	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62
S	mg/kg	D5453	± 5	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
RON	-	D2699	± 2	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93	93
MON	-	D2700	± 2	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
(R + M)/2	-	Calc.	± 2	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
C	mass %	Calc.	-	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report
H	mass %	D4808 Method A	-	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report
O	mass %	D5599	-	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report
Water Content	mg/kg	E1064	-	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report
Net Heat of Combustion	MJ/kg	D4809	-	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report
Oxidation Stability	minute	D525	-	>240	>240	>240	>240	>240	>240	>240	>240	>240	>240	>240	>240	>240	>240	>240	>240	>240	>240	>240
Copper Strip Corrosion, 3h at 122°F	-	D130	-	<No. 1	<No. 1	<No. 1	<No. 1	<No. 1	<No. 1	<No. 1	<No. 1	<No. 1	<No. 1	<No. 1	<No. 1	<No. 1	<No. 1	<No. 1	<No. 1	<No. 1	<No. 1	<No. 1	<No. 1
Solvent-Washed Gum Content	mg/100 ml	D381	-	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5

Appendix C

Mobile Source Observation Data Entry Instructions

for 'Comprehensive Gasoline Light Duty Exhaust Fuel Effects Test Program to Cover Multiple Fuel Properties and Two Ambient Test Temperatures'

GENERAL REQUIREMENTS: The contractor shall in general fill out the data tables completely and as best they are able using the supporting documentation and tables. If they have questions they should contact the project officer (PO) to receive guidance. If the contractor believes the categories presented are inadequate or incorrect they shall, in consort with the PO, define new categories for the data entry. If the value is not known or cannot be known the fields appropriate null value shall be taken from the table qc_specs.dbf. Values that are null shall be indicated with FoxPro's value for the true null. It is entered with the command 'replace fieldname with null'.

VEHICLE/EQUIPMENT INFORMATION:

Vehicle/equipment information is data which is required by the equipment procurement data table, equip_in.dbf and shall be recorded as soon as a piece of equipment is in contractor's custody. The equip_in.dbf data table shall be delivered to the project officer along with the test data. In some instances the effort to obtain accurate data for the equip_in table may be prohibitive. The contractor shall contact the project officer if certain fields follow that pattern. The project officer shall determine if populating a particular field with null is appropriate. The equip_in fields shall be populated as follows:

- The vehicle's (not the engine's) VIN shall be entered into the field equip_in.veh_ms_id. If a VIN is not found a unique identifier shall be used in it's place.

- The engine's serial number shall be entered into the field equip_in.eng_ms_id. The serial number for an engine is generally imprinted on a metal plate which is attached to the block. It is generally preceded by "S/N" or some similar designation. If a serial number is not available the contractor shall enter the VIN in backwords.

- The allowable values for equipment procurement methodologies to be used in

this contract are located in the field procmeth.procmeth from the procmeth.dbf table. The field procmeth.procmeth_d. in this same table describes each of the allowable values. In this contract the procurement method

- The value "YES" shall be recorded in the field equip_in.highway.
- A "POV" shall be entered into the field equip_in.purpose.
- "2201020110" shall be entered for the "LDGT", and "2201001000" for the type "LDGV" shall be entered into the field equip_in.scc.
- The vehicle's odometer value shall be entered into the field equip_in.proc_odom. If the odometer is broken the value for the field shall be null.
- The field equip_in.hour_meters shall be null.
- "GAS" shall be entered into the field equip_in.fueltype.
- The vehicle manufacturer's name shall be selected from the field company.company from the table company.dbf and entered into the field equip_in.vehcompany.
- The engine manufacturer's name shall be selected from the field company.company from the table company.dbf and entered into the field equip_in.engcompany.
- The vehicle's nominal engine displacement in cubic inches shall be entered in the field equip_in.disp_cid. If the engine displacement is labeled in liters or cubic centimeters this field shall be reported as null.

Appendix C
Mobile Source Observation Data Entry Instructions
for 'Comprehensive Gasoline Light Duty Exhaust Fuel Effects Test Program to Cover Multiple Fuel Properties and Two Ambient Test Temperatures'

- The vehicle's engine displacement in liters shall be entered in the field equip_in.disp_liter. If the engine displacement is labeled in cubic centimeters that value shall be multiplied by 1000, and reported to the nearest tenth of a liter. If the engine displacement is labeled in cubic inches this field shall be reported as null.

- The allowable values for the method of fuel delivery for a vehicle are found in the field fuel_del.fuel_deliv and their description in the field fuel_del.fuel_del_d. The correct fuel delivery code for the vehicle shall be reported in the field equip_in.fuel_deliv. The vehicles in this contract will all probably have fuel injection, "FI" or carburated "CARB".

- The correct fuel injection method for the unit shall be reported in the field equip_in.fi_type. The allowable values to indicate the type of fuel injection are found in the field fi_type.fi_type in the fi_tytpe.dbf table and are described in the field fi_type.fi_type_d. All of the equipment procured under this contract is expected to be described as "DIRECT", "PFI" (Port Fuel Injection), "TBI" (Throttle Body Inject) though "INDIR" shall be used, as appropriate.

- The allowable values to describe the process by which intake air enters the engine for combustion are found in the field aspirate.aspirated in the table aspirate.dbf and are described in the field aspirate.apirate_d. The correct value for the engine to be tested within the equipment shall be reported in the field equip_in.aspirated.

- The number of cylinders in the engine to be tested is recorded in the field equip_in.cylinder.

- The allowable values to describe the type of catalyst which is present on the

vehicle are located in the field cat_type.cat_type in the table cat_type.dbf and are described in the field cat_type.cat_type_d. The correct value shall be reported in the field equip_in.cat_type.

- The allowable values to indicate that the catalyst control configuration is close loop are "YES" or "NO".

- An appropriate value indicating the vehicle class shall be selected from vehclass.vehclass and recorded in the field equip_in.vehclass.

- The equipment's model year will be reported into the field equip_in.model_yr in the 4-digit century inclusive format. If this information is not known, null shall be entered in this field.

- The vehicle make shall be recorded in the field equip_in.make.

- The vehicle model name given to the vehicle by the vehicle manufacturer shall be entered into the field equip_in.model_name.

- The equipment build date shall be recorded in the date field equip_in.v_bld_date. The format shall be MM/DD/YY. If the actual date is not reported on the equipment or in supporting literature about the particular unit, then the build date shall be reported as MM/15/YY. If the build date cannot be determined, the null date value shall be reported.

- The engine build date shall be recorded in the date field equip_in.e_bld_date. The format shall be MM/DD/YY. If the actual date is not reported on the engine or in supporting literature about that particular engine, then the build date shall be reported as MM/15/YY. If the build date cannot be determined, the null shall be reported.

- The number of fuel tanks on the piece of equipment shall be reported in the field equip_in.fueltanks. If this information is not known, null shall be entered in this field.

- The equipment's total fuel capacity is recorded to the nearest gallon in the field equip_in.tank_cap. Fuel capacity is to be determined by the following hierarchy; labeling found directly on the physical tank(s), OEM service manual, replacement part manual(s), and owner's manual. If this information can not be determined, null shall be entered in this field.

- The engine exhaust emission certification family designation shall be recorded in the field equip_in.eng_fam. If this information can not be determined, null shall be entered in this field. Known values for the engine family are found in the table eng_fam.eng_fam.

- The engine evaporative emission certification family designation shall be recorded in the field equip_in.evap_fam. If this information can not be determined, null shall be entered in this field. Known values for the engine family are found in the table evap_fam.evap_fam.

- The allowable values for the equipment drive train description are found in the field drv_trn.dvr_trn of the table drv_trn.dbf and are described in the associated field dvr_trn.drv_trn_d. The correct value for the unit's drive train shall be reported in the field equip_in.drv_trn.. If this information is not known, null shall be entered in this field.

- The engine series or product line name shall be entered into the field engine.engseries. If this information is not known, null shall be entered in this field.

- An appropriate value for engine service class shall be selected from eng_clas.eng_class and shall be recorded in the field equip_in.eng_class. If this information is unknown or cannot be determined, null shall be entered in this field.

- The vehicle model year shall be recorded into the field equip_in.eng_mod_yr unless the engine is known to be of a different model year than the vehicle.

- The type of aftercooling found on the engine shall be reported in the field equip_in.cooling. If the engine is not equipped with an aftercooling device, then "NONE" shall be recorded. If it is not known whether the engine has aftercooling as normally configured, null shall be recorded.

- The method of fuel injection shall be recorded in the field equip_in.f_meth The allowable values for fuel injection method are found in the field f_met.f_meth in the table f_meth.dbf and are described in the field f_meth.f_meth_d.. While most diesel engines are covered by the DI and IDI values, the contractror is encouraged to identify the fuel injection method as specifically as possible. If this information is unknown or cannot be determined for the test engine, null shall be entered in this field.

- The engine manufacturer-specified fuel injection pressure for the fuel injection system, if present, on the test engine shall be recorded in the field equip_in.f_press. If this information is unknown, null shall be entered in this field.

- The value "YES" shall be recorded in the field equip_in.except if there is anything which is known to be or is obviously exceptional about an engine or vehicle which would cause the test unit to be an outlier in most statistical analyses involving the equipment or engine. Otherwise, the value "NO" shall be recorded in the equip_in.except field.

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- A brief description of the quality or qualities which would make an engine or vehicle exceptional shall be entered in the field equip_in.ex_comm. This field is used in conjunction with the equip_in.except field. Otherwise, the equip_in.ex_comm field shall be left blank.

- If an engine or vehicle is to be tested with a particulate trap or filter in place, then the value "YES" shall be recorded in the field equip_in.parttrap otherwise the value "NO" shall be recorded instead. If this information is unavailable or cannot be determined, then null shall be entered in the equip_in.parttrap field.

- The value "4" shall be recorded in the field equip_in.eng_cycl for engines with a four cycle system. The value "2" shall be recorded for engines with a two cycle system.

- The engine manufacturer's specified maximum power value (in units of brake-specific horsepower) at rated engine speed shall be recorded in the field equip_in.ratedpower. If this information is unknown or cannot be determined from the engine or in supporting literature about that particular engine, null shall be recorded in the field.

- The engine manufacturer's specified rated engine speed (in units of rpm) shall be recorded in the field equip_in.ratedspeed. If this information is unknown or cannot be determined from the engine or in the service information about that particular engine, null shall be recorded in the field.

- The engine's peak torque shall be reported in foot -pounds into the field equip_in.peaktorque. If it can not be determined the value entered shall be null.

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- The engine's speed where peak torque is obtained shall be reported in rpms into the field equip_in.peakspeed. If it can not be determined the value entered shall be null.

- The engine's fuel rate at peak torque speed in lbs per hour shall be reported into the field equip_in.peakfrate. If it can not be determined the value entered shall be null.

- The engine's fuel rate at rated speed in lbs per hour shall be reported into the field equip_in.ratedfrate. If it can not be determined the value entered shall be null.

- The engine manufacturer's specified engine speed (in units of rpm) for engine idle operation shall be recorded in the field equip_in.idle_rpm. If it can not be determined the value entered shall be null.

- If the number of times that the test engine has been rebuilt is known or can be determined, that number shall be recorded in the field equip_in.rebuild_ct. If it can not be determined the value entered shall be null.

- The date of the last engine rebuild shall be recorded in the field equip_in.rebuild_dt. If it can not be determined the value entered shall be null.

- For the last rebuild of the test engine only, if the reason that the test engine was rebuilt is known or can be determined, then that reason shall be described in the field equip_in.rebuildwhy. If it can not be determined the value entered shall be null.

- The allowable values to categorize a vehicle's transmission are found in the

field tran_typ.tran_type. The correct value for the vehicle shall be reported in the field equip_in.tran_type.

- The number of fuel injectors per cylinder shall be reported in the field equip_in.injectors. Typical values are as follows "0" for carbureted engines, "1" for most SI engines.

- This represents what method, if any, was used to introduce supplemental air into the exhaust stream. Legal values are found and defined by AIR_INJ translation table. "NO" shall be recorded in the field equip_in.air_inj when no supplemental air was introduced. Other legal values are listed below:

  "YES" - Has air injected
  "PUMP" - Air injected by pump
  "PULSE" - Air injected by pulse

- The allowable values to indicate the catalyst control configuration are "YES" or "NO". The correct value for the vehicle shall be reported in the field equip_in.closedloop. If this information is not known, the value "NUL" shall be entered in this field.

- "SI" shall be reported for in the field equip_in.ignition.

- If the transmission has an overdrive gear, "YES" shall be recorded in the field equip_in.overdrive. Otherwise it shall be "NO". If it can not be determined the value entered shall be null.

- If the transmission has a creeper gear, "YES"" shall be recorded in the field equip_in.creeper. Otherwise it shall be "NO". If it can not be determined the value entered shall be null.

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- If the transmission is equipped with a lock-up torque converter , "YES"" shall be recorded in the field equip_in.lockup. Otherwise it shall be "NO". If it can not be determined the value entered shall be null

- The number of forward gears shall be reported in the field equip_in.gears. If it can not be determined the value entered shall be null

- Vehicle curb weight, (as defined ' CFR86.082-2) is the weight of the vehicle with all fluids at their nominal (full) capacity, including fuel. The value is not the same as the equivalent test weight. There is, however, an exception for "incomplete" vehicles in the above CFR quote. A chassis destined to become a camper is an example of such a vehicle. In the case of an "incomplete" curb weight is specified by the manufacturer. The contractor shall follow the definition where it applies. In general vehicle curb weight shall be determined by weighing the vehicle and adding an estimated additional weight that would occur if the vehicle's fuel tanks were full. That value shall be reported in the field equip_in.curbweight. For computational purposes, the default weight for a gallon of gasoline fuel shall be 6.1 pounds.

- If the vehicle has air conditioning "YES" shall be entered into the field equip_in.ac. If the vehicle has no air conditioning, then "NO" is entered. If you do not known if the vehicle has air conditioning, null shall be entered into the field equip_in.ac.

- An appropriate value shall be selected from the field canister.canister and entered into the field equip_in.canister.

- If there is no exhaust gas recirculation, the value entered in the field equip_in.egr shall be "NO". If the engine has exhaust gas recirculation, the value shall be "YES". If its is unknown the value entered shall be null.

- Null shall be reported in the field equip_in.egr_type only if the equip_in.egr field contains either a "NO" or "NUL". If the engine has exhaust gas recirculation then either "HOT" for hot air recirculation, "COOLED" for cool air recirculation shall be reported in the equip_in.egr_type.

- The gross vehicle weight rating (GVWR) shall be entered into the field equip_in.gvwr.

- The field equip_in.comments shall be used to identify/explain anything a vehicle was rejected from the test program. Otherwise the fields shall be null

- The ownership of the vehicle shall be reported into the field equip_in.ownership. The legal values are either "PRIVATE" - privately owned vehicle; "RENTAL" - rented vehicle; or "GOVT" - owned by local, state, or federal government.

- The location from where the vehicle normally resides shall be reported into the field equip_in.depot.

- The vehicle's NOx emission standard in grams per mile shall be entered into the field equip_in.noxstd.

- The vehicle's CO emission standard in grams per mile shall be entered into the field equip_in.costd.

- The vehicle's THC emission standard in grams per mile shall be entered into the field equip_in.thcstd.

- The vehicle's PM emission standard in grams per mile shall be entered into the field equip_in.pmstd.

- The number of axles on the vehicle shall be entered into the field equip_in.axle.

- Null shall be reported in the remaining fields in the equip_in table.

VEHICLEINSPECTIONS:

Inspection of vehicle beyond that charaterize exhuast smoke color shall be entered into the table Insp_in.dbf. The data shall be entered in the following manner.

- A unique identifier for the inspection shall be entered into the field insp_in.ctr_tst_id

- "FUEL_PROPA" shall be entered into the field insp_in.wa_id.

- The value found in equip_in.veh_ms_id shall be recorded in insp_in.ms_id.

- "KANSAS_CITY" shall be recorded in the field insp_in.site

- The date of the inspection shall be recorded in the field insp_in.site.

- The time of the inspection shall be recorded in the field insp_in.test_tod using the format (HH:MM).

- Unless there is some extraordinary observation of the vehicle the values for insp_in.comments and insp_n.comments2 shall be null.

- The vehicle odometer at the time of the inspection shall be recorded in the field insp_in.insp_odom.

- The fields hsp_h.g_can_hit, hsp_h.g_can_purg, and hsp_h.g_can_load shall be recored as nul.

- The appropriate value for vehicle tailpipe smoke shall be recorded in the field hsp_h.smokecolor.

OBDSCAN:

A scan of the Onboard diagnostic system shall be performed as part of the vehicle inspection. The scan level information shall be recorded in obd_h.dbf. The table shall be populated as follows:

- The laboratory scan id shall be recorded in the field obd_h.ctr_tst_id.

- "FUEL_PROPA" shall be reported in the field obd_h.wa_id.

- The value found in equip_h.veh_ms_id for the vehicle shall be reported in the field obd_h.ms_id.

- "KANSAS_CITY" shall be reported in the field obd_h.site.

- The date and time of the inspection shall be reported in the fields obd_h.obd_date and obd_h.obd_tod.

- Any narrative needed to describe an unusual condition shall be recorded in obd_h.comment.

- The vehicle odometer at the time of the vehicle inspection shall be recorded in the field obd_h.hsp_odom.

- If the vehicle is equipped with an onboard diagnostic system that is not identifiable the value "0" shall be shall be reported in the field obd_in.obdlevel. If the vehicle is equipped with onboard diagnostic system that precedes SAE J2012 Jul 96 (OBD2) the value "1" shall be shall be reported in the field obd_in.obdlevel. If the vehicle is equipped with an onboard diagnostic systems that conforms to SAE J2012 Jul 96 (OBD2), the value "2" shall be reported in the field obd_in.obdlevel. If there is no onboard diagnostic system the value "9" shall be shall be reported in the field obd_in.obdlevel.

If the vehicle is equipped with an onboard diagnostic system that precedes SAE J2012 Jul 96, the individual codes shall be recorded in the table scan1_in.dbf where the values shall be reported in the fields as follows:

- The laboratory scan id used obd_in.ctr_tst_id shall be recorded in the field scan1_in.ctr_tst_id.

- The 2 character OBD code shall be reported in the field scan1_in.obd1code.

- A narrative (50 characters in length or less) describing the meaning of the code shall be reported on scan1_in.obd1descr.

If the vehicle is equipped with an onboard diagnostic system that conforms to SAE J2012 Jul 96 (OBD2), the individual codes shall be recorded in the table scan2_in.dbf where the values shall be reported in the fields as follows:

- The laboratory scan id used obd_in.ctr_tst_id shall be recorded in the field scan2_in.ctr_tst_id.

- The 5 character OBD code shall be reported in the field scan2_in.obd2code.

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VEHICLEREPAIRS:

All repairs shall be documented and reported to the WAM through a record in the format of the table repar_in.dbf and by populating the fields as follows:

- The value found in equip_in.veh_ms_id for the vehicle scanned shall be reported in the field repar_in.ms_id.

- The date and time of the repair shall be reported in the field repar_in.repar_date and repar_in.repar_tod respectively.

- "FUEL_PROPA" shall be reported in the field repar_in.wa_id.

- "SANANOTO" shall be reported in the field repar_in.site.

- The laboratory test or repair id shall be reported in the field repar_in.ctr_trst_id.

- The repair shall be categorized with a numeric code associated against a descriptions in the field rep_type.rep_desc . The numeric code is found in the field rep_type.rep_type and shall be reported in the field repar_in.rep_type.

- A narrative to describe the repair shall be entered in the comment field repar_in.comments. If more space is needed, additional information shall be reported in the field repar_in.comments2.

- The vehicle odometer at the time of the repair shall be reported in the field repar_in.repar_odom.

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TEST FUEL BATCHES:

Test fuel properties are stored in the fields of the table fbat_in.dbf. Each fuel batch shall if know shall have its own unique record and is populated as follows;

- The laboratory fuel batch identifier shall be recorded in field fbat_in.fbatch_id.
- If the fuel manufacture has provided the laboratory a unique identifier for the test fuel that shall be recorded in the field fbat_in.mfg_batch. If none was supplied null shall be entered into this field
- Null shall be entered into the field fbat_in.cetane_num.
- Null shall be entered into the field fbat_in.cetane_idx.
- Null shall be entered into the field fbat_in.cetane_imp.
- Null shall be entered into the field fbat_in.cetane_typ..
- The concentration of sulfur in the test fuel in ppm shall be reported in the field fbat_in.sulfur. If it was not measured the value null shall be entered.
- Null shall be entered into the field fbat_in.sulf_agent.
- Null shall be reported in the field fbat_in.nitrogen. If it is not known null shall be entered into the field.
- Null shall be reported in the field fbat_in.tarom.

- Null shall be reported in the field fbat_in.marom

- Null shall be reported in the field fbat_in.parom. If it was not measured or known null shall be entered into the field.

- The test fuel's distillation properties as measured with ASTM D 86 shall be entered into the appropriate fields of fbat_in.IBP, fbat_in.t10, fabatch.t50, fbat_in.t90, fbat_in.ep, fbat_in.residue, fbat_in.loss, and fbat_in.recovery. If it was not measured or known null shall be entered into the field.

- The test fuel's relative density as specific gravity at 60°F shall be entered into the field fbat_in.spec_grav. If it was not measured or known null shall be entered into the field.

- The test fuel's relative density as Degrees API at 60°F shall be entered into the field fbat_in.api_grav. If it was not measured or known null shall be entered into the field.

- Null shall be entered into the field fbat_in.viscosity.

- Null shall be recorded in the field fbat_in.flash.

- Null shall be recorded in the field fbat_in.pour.

- Null shall be reported in the field fbat_in.hcratio.

- The test fuel's oxygen content on a weight percent basis shall be reported in the field fbat_in.oxygen. If it was not measured or known null shall be entered into the field.

- The compound contributing the oxygen on the test fuel shall be reported in

the field fbat_in.oxy_type. If there is no oxygen in the test fuel that "NONE" shall be reported in the field fbat_in.oxy_type. If it was not measured or known null shall be entered into the field.

- Null shall be reported in the field fbat_in.additives.
- Null shall be entered into the field fbat_in.lubric.
- Null shall be entered into the field fbat_in.lubric_mm.
- The calculated net heating content of the fuel shall be reported in the field fbat_in.heat. If it was not measured or known null shall be entered into the field.
- Null shall be reported in the field fbat_in.ash.
- If the fuel is a gasoline the motor octane will be entered in the former and the research octane shall be entered in the latter. If it was not measured or known null shall be entered into the field.
- If the fuel is a gasoline then its RVP shall be recorded in the field fbat_in.rvp. If it was not measured or known null shall be entered into the field.
- The grams of carbon per pound of test fuel in dry air shall be reported in the field fbat_in.fen_c. If it was not measured or known null shall be entered into the field.
- The weight fraction carbon of the test fuel shall be reported in the field fbat_in.wgt_fractn. If it was not measured or known null shall be entered into the field.

- The aromatic content of the test fuel in volume percent and as measured by ASTM D 1319 shall be reported in the field fbat_in.comp_aroma. If it was not measured or known null shall be entered into the field.

- The olefin content of the test fuel in volume percent and as measured by ASTM D 1319 shall be reported in the field fbat_in.comp_olefn. If it was not measured or known null shall be entered into the field.

- The saturate content of the test fuel in volume percent and as measured by ASTM D 1319 shall be reported in the field fbat_in.comp_sat. If it was not measured or known null shall be entered into the field.

- If the test fuel is the certification gasoline "60" shall be reported in the field fbat_in.fuel_id. If the fuel is tank fuel the field dyno_in.fuel_id shall be "0".

- "FUEL_PROPA" shall be entered in the field equip_in.wa_id.

- 'Null' shall be report in the field fbat_in.cloud.

LABORATORY TESTING: The the CARB Unified Cycle aka LA92 shall be run as a cold start three phase test. The laboratory test level information shall be reported in the table structure headed by dyno_in.dbf for laboratory values and are to be populated for the tests as follows:

- The laboratory test identifier shall be recorded in field dyno_in.ctr_tst_id.

- "LA92C" shall be reported in the field dyno_in.test_proc.

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- "FUEL_PROPA" shall be entered into the field dyno_in.wa_id.
- "LA92" shall be reported in the field dyno_in.sched_id.
- The initial LA92C shall have the value .F. entered into the field dyno_in.replicate. If a second LA92C is done under a vehicle's procurement the value .T. entered into the field dyno_in.replicate.
- If the test fuel is the certification gasoline, which it shall be for the correlation vehicles, "60" shall be reported in the field dyno_in.fuel_id. If the fuel is tank fuel the field dyno_in.fuel_id shall be "0".
- If a fuel analyses was performed on the fuel used for the test the value of the fuel analyses fbat_in.fbatch_id shall be reported in the field dynob_in.fbatch_id.
- The value entered into equip_in.veh_ms_id for this vehicle shall be reported in the field dyno_in.ms_id.
- The test date and time of day shall be reported into the fields dyno_in.test_date and dyno_in.test_tod respectively following the format specified for them.
- "SANANTON " shall be reported in equip_in.site.
- The target temperature for the test shall be reported in the field dyno_in.nom_temp. Most of which are at the FTP condition of 75 °F, but the cold temperature tests shall have a target temperature of 50 °F.
- The target humidity in grains of water per pound of dry air at 60 °F shall be reported in the field dyno_in.nom_humid.

- "0" shall be entered into the field dyno_in.disable.
- CARB unified cycle composite emissions for THC, CO, NOx, CO2, and PM shall be reported in the fields dyno_in.thc, dyno_in.co, dyno_in.co2, dyno_in.nox, and dyno_in.mpg.
- The vehicle's ETW shall be entered into the field dyno_in.testwght.
- The dynamometer's indicated road load horse power at 50 miles per hour shall be entered into the field dyno_in.road_hp.
- "NO" shall be entered into the field dyno_in.ac_hp.
- The appropriate value for the dynotype from the table dynotype shall be entered into the field dyno_in.dynotype
- The vehicle's odometer reading at the start of the test shall be entered into the field dyno_in.odometer.
- "FUEL_PROPA" shall be reported in the field dyno_in.precond.
- The ambient temperature in degrees F at the start of the test shall reported in the field dyno_in.int_temp.
- The barometric pressure in inches of mercury at the start of the test shall be entered into the field dyno_in.int_baro.
- The humidity in grains of water per pound of dry air at the start of the test shall entered into the field dyno_in.int_humid.

- The field dynob_in.resultgrp shall be null.

- The target dyno coefficients shall be entered into the fields dynob_in. dynotarg_a, dynob_in. dynotarg_b, and dynob_in. dynotarg_c.

- The set dyno coefficients shall be entered into the fields dynob_in.dynoco_a, dynob_in.dynoco_b, and dynob_in.dynoco_c.

- The ctr_tst_id of the vehicle's procurement record in equip_in shall be entered into the field dynob_in.ctr_tst_id_p.

CARB composite emissions for PM, the air toxic compounds shall be reported in the table format tmeas_in.dbf. The fields shall be populated as follows:

- The appropriate value for meastype shall be reported as tmeas_in.meas_id if being measured.

- The laboratory test id shall be reported in the field tmeas_in.ctr_tst_id and the same as that in dyno_in.ctr_tst_id.

- The composite meastype emissions in grams per mile shall be reported in the field tmeas_in.measure.

Bag (phase) level test data shall be reported for laboratory values in the table format bag_in.dbf where
the fields shall be populated as follows:

- The bag (phase) number, "1" , "2" or "3" shall be reported in the field bag_in.bag_num.

- The laboratory test id used for the test level information shall be reported

in bag_in.ctr_tst_id and the same as that in dyno_in.ctr_tst_id.

- The average barometric pressure in inches of mercury shall be reported in the field bag_in.bag_baro
- The average test cell temperature in degrees F shall be reported in the field bag_in.bag_temp.
- The average test cell humidity in grains of water per pound of dry air at 60 °F shall be reported in the field bag_in.bag_humid.
- The total simulated distance traveled by the vehicle per phase in miles shall be reported in the field bag_in.bag_dist.
- Total hydrocarbon shall be reported as grams per mile in the field bag_in.bag_thc.
- Carbon monoxide shall be reported as grams per mile in the field bag_in.bag_co.
- Carbon dioxide shall be reported as grams per mile in the field bag_in.bag_co2.
- Oxides of nitrogen shall be reported as grams per mile in the field bag_in.bag_nox.
- The vehicle's fuel consumption in miles per gallon per phase shall be reported in the field bag_in.bag_mpg.

The phase (bag) level meastype emissions shall be reported in the table format bmeas_in.dbf. The fields shall be populated as follows:

- The phase (bag) number shall be reported in the field bmeas_in.bag_num.

- Appropriate value for the meastype from the table meastype shall be reported as bmeas_in.meas_id if measured.

- The laboratory test id shall be reported in the field bmeas_in.ctr_tst_id and the same as that in dyno_in.ctr_tst_id.

- The phase (bag) meastype emissions in grams per mile shall be reported in the field bmeas_in.measure.

Second by second emission data for the laboratory test measurement shall be reported in the table format time_in.dbf where the fields shall be populated as follows:

- The accumulated test time in seconds shall be reported in the field time_in.dynosecs.

- The laboratory test id shall be reported in the field time_in.ctr_tst_id and the same as that in dyno_in.ctr_tst_id.

- The average speed for the measured unit of time (1 second) shall be reported in miles per hour in the field time_in.speed.

- The simulated distance traveled by the vehicle for the measured unit of time (1 second) in miles shall be reported in the field time_in.dist.

- Total hydrocarbon for the measured unit of time (1 second) shall be reported in grams per second in the field time_in.r_thc.

- Carbon monoxide for the measured unit of time (1 second) shall be reported in grams per second in the field time_in.r_co.

- Oxides of nitrogen for the measured unit of time (1 second) shall be reported in grams per second in the field time_in.r_nox.
- Carbon dioxide for the measured unit of time (1 second) shall be reported in grams per second in the field time_in.r_co2.

- The phase number shall be reported in the field time_in.test_phase.

Second by second non-core mass measurements such as the QCM mass or any other non-core analyte shall be recorded in the table rmeas_in.

- The appropriate meastype for the analyte in question shall be entered in the field rmeas_in.meas_id.

- The cumulative seconds for the record analyte shall be entered into the field rmeas_in.dynosecs.

- The contractors unique test identifier shall be recorded in the field rmeas_in.ctr_tst_id.

- The measured value in its appropriate units is identified in the meastype table shall be entered into the field rmeas_in.rep_meas.

Second by second laboratory data collected by the instrumentation before the calculation of mass emissions shall be stored in the table ltime_in.dbf. If the mentioned parameters can not be measured the mentioned fields shall be reported as null

Appendix C
Mobile Source Observation Data Entry Instructions
for 'Comprehensive Gasoline Light Duty Exhaust Fuel Effects Test Program to Cover Multiple Fuel Properties and Two Ambient Test Temperatures'

- The accumulated test time in seconds shall be reported in the field ltime_in.dynosecs. This field cannot be null.

- The laboratory test id shall be reported in the field ltime_in.ctr_tst_id and the same as that in dyno_in.ctr_tst_id. This field cannot be null.

- The vehicle's engine speed in rpm shall be store in the field ltime_in.rpm.

- The vehicle's engine torque in foot pounds per sec shall be reported in the field ltime_in.lab_torq.

- The ambient temperature if measured on a continuous basis shall be entered into ltime.lab_tempf in degrees F.

- The barometric pressure if measured on a continuous basis shall be entered into ltime.lab_baro in inches of mercury per second.

- The humidity if measured on a continuous basis shall be entered into ltime.lab_humid in grains per pound of dry air at 60 degrees F.

- Fuel rate if measured on a continuous basis shall be entered into ltime.lfuel_rate in pounds per second.

- Engine coolant temperature if measured on a continuous basis shall be entered into ltime.lab_engcol in degrees F.

- Engine oil temperature if measured on a continuous basis shall be entered into ltime.lab_engoil in degrees F.

- The status of the malfunction indicator light (milight) if measured on a continuous basis shall be entered into ltime.lab_milt in degrees F.

- Oxygen concentration as measured at the tailpipe if measured on a continuous basis shall be entered into ltime.tp_o2 in volume percent.

- Oxygen concentration as measured in the CVS diluted sample stream if measured on a continuous basis shall be entered into ltime.di_o2 in volume percent.

- Tail pipe exhaust volume in standard cubic feet per second shall be entered into ltime.tp_vol.

- Constant volume sampler flow in standard cubic feet per second shall be entered into ltime.cvs_vol.

- Dilution air flow in standard cubic feet per second shall be entered into ltime.di_vol.

- Carbon dioxide concentration as measured at the tailpipe if measured on a continuous basis shall be entered into ltime.tp_co2 in volume percent.

- Carbon dioxide concentration as measured in the CVS diluted sample stream if measured on a continuous basis shall be entered into ltime.di_co2 in volume percent.

- Total hydrocaron concentration as measured at the tailpipe if measured on a continuous basis shall be entered into ltime.tp_thc in parts per million.

- Total hydrocaron concentration as measured in the CVS diluted sample stream if measured on a continuous basis shall be entered into ltime.di_thc in parts per million.

- Oxides of Nitrogen concentration as measured at the tailpipe if measured on a continuous basis shall be entered into litime.tp_nox in parts per million.

- Oxides of Nitrogen concentration as measured in the CVS diluted sample stream if measured on a continuous basis shall be entered into item.di_nox in parts per million.

- Carbon monoxide concentration as measured at the tailpipe if measured on a continuous basis shall be entered into item.tp_co in parts per million.

- Carbon monoxide concentration as measured in the CVS diluted sample stream if measured on a continuous basis shall be entered into item.di_co in parts per million.

Appendix D - Speciated VOC needed from EPAct testing
Updated to reflect all compounds requested 9-13-07 MGC

CAS	NAME	SPEC_MW
74-82-8	Methane	16.04246
74-86-2	Acetylene	26.03728
74-85-1	Ethylene	28.05316
50-00-0	Formaldehyde	30.02598
74-84-0	Ethane	30.06904
67-56-1	Methyl alcohol	32.04186
463-49-0	1,2-propadiene	40.06386
74-99-7	1-propyne	40.06386
115-07-1	Propylene	42.07974
75-07-0	Acetaldehyde	44.05256
74-98-6	Propane	44.09562
64-17-5	Ethyl alcohol	46.06844
689-97-4	Vinylacetylene	52.07456
106-99-0	1,3-butadiene	54.09044
460-12-8	1,3-butadiyne	54.09044
590-19-2	1,2-butadiene (methylallene)	54.09044
107-02-8	Acrolein (2-propenal)	56.06326
106-98-9	1-butene	56.10632
107-01-7	2-Butene	56.10632
115-11-7	Isobutylene	56.10632
590-18-1	Cis-2-butene	56.10632
624-64-6	Trans-2-butene	56.10632
123-38-6	Propionaldehyde	58.07914
67-64-1	Acetone	58.07914
106-97-8	N-butane	58.1222
75-28-5	Isobutane	58.1222
142-29-0	Cyclopentene	68.11702
2004-70-8	Trans-1,3-pentadiene	68.11702
78-79-5	Isoprene	68.11702
4170-30-3	Crotonaldehyde	70.08984
78-85-3	2-methyl-2-propenal	70.08984
109-67-1	1-pentene	70.1329
287-92-3	Cyclopentane	70.1329
513-35-9	2-methyl-2-butene	70.1329
563-45-1	3-methyl-1-butene	70.1329
563-46-2	2-methyl-1-butene	70.1329
627-20-3	Cis-2-pentene	70.1329
646-04-8	Trans-2-pentene	70.1329
123-72-8	Butyraldehyde	72.10572
78-93-3	Methyl ethyl ketone (2-butanone)	72.10572
109-66-0	N-pentane	72.14878
463-82-1	2,2-dimethylpropane	72.14878
78-78-4	Isopentane	72.14878
71-43-2	Benzene	78.11184
110-83-8	Cyclohexene	82.1436
1120-62-3	3-methylcyclopentene	82.1436
1759-81-5	4-Methylcyclopentene	82.1436
693-89-0	1-Methylcyclopentene	82.1436
110-82-7	Cyclohexane	84.15948
13269-52-8	Trans-3-hexene	84.15948
4050-45-7	Trans-2-hexene	84.15948
592-41-6	1-hexene	84.15948
625-27-4	2-methyl-2-pentene	84.15948
674-76-0	4-methyl-trans-2-pentene	84.15948
691-37-2	4-methyl-1-pentene	84.15948

Appendix D - Speciated VOC needed from EPAct testing
Updated to reflect all compounds requested 9-13-07 MGC

CAS	NAME	SPEC_MW
760-20-3	3-methyl-1-pentene	84.15948
763-29-1	2-methyl-1-pentene	84.15948
7642-09-3	Cis-3-hexene	84.15948
7688-21-3	Cis-2-hexene	84.15948
922-61-2	3-methyl-2-pentene	84.15948
96-37-7	Methylcyclopentane	84.15948
590-86-3	Isovaleraldehyde	86.1323
107-83-5	2-methylpentane	86.17536
110-54-3	N-hexane	86.17536
75-83-2	2,2-dimethylbutane	86.17536
79-29-8	2,3-dimethylbutane	86.17536
96-14-0	3-methylpentane	86.17536
1634-04-4	Methyl t-butyl ether	88.14818
108-88-3	Toluene	92.13842
10574-36-4	3-methyl-cis-2-hexene	98.18606
10574-37-5	2,3-dimethyl-2-pentene	98.18606
108-87-2	Methylcyclohexane	98.18606
14686-13-6	Trans-2-heptene	98.18606
14686-14-7	Trans-3-heptene	98.18606
4038-04-04	3-Ethylpentene	98.18606
1638-26-2	1,1-dimethylcyclopentane	98.18606
1640-89-7	Ethylcyclopentane	98.18606
1759-58-6	Trans-1,3-dimethylcyclopentane	98.18606
2213-32-3	2,4-dimethyl-1-pentene	98.18606
2532-58-3	Cis-1,3-dimethylcyclopentane	98.18606
2738-19-4	2-methyl-2-hexene	98.18606
3404-62-4	5-methyl-cis-2-hexene	98.18606
3683-22-5	4-methyl-trans-2-hexene	98.18606
3769-23-1	4-methyl-1-hexene	98.18606
3899-36-3	3-methyl-trans-3-hexene	98.18606
4914-89-0	3-methyl-cis-3-hexene	98.18606
625-65-0	2,4-dimethyl-2-pentene	98.18606
6443-92-1	Cis-2-heptene	98.18606
7385-78-6	3,4-dimethyl-1-pentene	98.18606
816-79-5	3-ethyl-2-pentene	98.18606
108-08-7	2,4-dimethylpentane	100.20194
142-82-5	N-heptane	100.20194
464-06-2	2,2,3-trimethylbutane	100.20194
562-49-2	3,3-dimethylpentane	100.20194
565-59-3	2,3-dimethylpentane	100.20194
589-34-4	3-methylhexane	100.20194
590-35-2	2,2-dimethylpentane	100.20194
591-76-4	2-methylhexane	100.20194
617-78-7	3-ethylpentane	100.20194
994-05-8	T-amylmethylether	102.17476
100-42-5	Styrene	104.14912
100-52-7	Benzaldehyde	106.12194
100-41-4	Ethylbenzene	106.165
108-38-3	M-xylene	106.165
108-38-3; 106-42-3	M & p-xylene	106.165
95-47-6	O-xylene	106.165
99363-12-9	1,2,4-trimethylcyclopentene	110.19676
107-39-1	2,4,4-trimethyl-1-pentene	112.21264
111-66-0	1-octene	112.21264
13389-42-9	Trans-2-octene	112.21264

Appendix D - Speciated VOC needed from EPAct testing
Updated to reflect all compounds requested 9-13-07 MGC

CAS	NAME	SPEC_MW
15890-40-1	Cis-1,trans-2,3-trimethylcyclopentane	112.21264
16747-50-5	1,1-Methylethylcyclopentane	112.21264
16883-48-0	Cis-1,trans-2,4-trimethylcyclopentane	112.21264
18679-30-6	Cis,trans,cis-1,2,4-trimethyl Cyclopentane	112.21264
19374-46-0	cis,trans,cis-1,2,3-trimethyl Cyclopentane	112.21264
2040-96-2	Propylcyclopentane	112.21264
2207-01-4	Cis-1,2-dimethylcyclohexane	112.21264
2207-03-6	Trans-1,3-dimethylcyclohexane	112.21264
2207-04-7	Trans-1,4-dimethylcyclohexane	112.21264
2613-65-2	Trans-1-methyl-3-ethylcyclopentane	112.21264
2815-57-8	1,2,3-trimethylcyclopentane	112.21264
3875-51-2	Cyclopentane, (1-methylethyl)-	112.21264
590-66-9	1,1-dimethylcyclohexane	112.21264
638-04-0	Cis-1,3-dimethylcyclohexane	112.21264
7642-04-8	Cis-2-octene	112.21264
111-65-9	N-octane	114.22852
540-84-1	2,2,4-trimethylpentane	114.22852
563-16-6	3,3-dimethylhexane	114.22852
565-75-3	2,3,4-trimethylpentane	114.22852
583-48-2	3,4-dimethylhexane	114.22852
584-94-1	2,3-dimethylhexane	114.22852
589-43-5	2,4-dimethylhexane	114.22852
589-53-7	4-methylheptane	114.22852
589-81-1	3-methylheptane	114.22852
590-73-8	2,2-dimethylhexane	114.22852
592-13-2	2,5-dimethylhexane	114.22852
592-27-8	2-methylheptane	114.22852
609-26-7	2-methyl-3-ethylpentane	114.22852
496-11-7	Indan	118.1757
620-23-5	Tolualdehyde	120.14852
103-65-1	N-propylbenzene	120.19158
108-67-8	1,3,5-trimethylbenzene	120.19158
526-73-8	1,2,3-trimethylbenzene	120.19158
611-14-3	1-Methyl-2-ethylbenzene	120.19158
620-14-4	1-Methyl-3-ethylbenzene	120.19158
622-96-8	1-Methyl-4-ethylbenzene	120.19158
95-63-6	1,2,4-trimethylbenzene (1,3,4-trimethylbenzene)	120.19158
98-82-8	Isopropylbenzene (cumene)	120.19158
124-11-8	1-nonene	126.23922
1678-92-8	Propylcyclohexane	126.23922
1839-63-0	1,3,5-trimethylcyclohexane	126.23922
6236-88-0	1-Methyl-4-ethylcyclohexane	126.23922
6434-77-1	Cis-2-Nonene	126.23922
7094-26-0	1,1,2-trimethylcyclohexane	126.23922
7094-27-1	1,1,4-trimethylcyclohexane	126.23922
7667-58-5	Cis,trans-1,2,4-trimethylcyclohexane	126.23922
7667-60-9	Cis-1,trans-2,trans-4-trimethylcyclohexane	126.23922
91-20-3	Naphthalene	128.17052
1068-19-5	4,4-dimethylheptane	128.2551
1069-53-0	2,3,5-trimethylhexane	128.2551
1071-26-7	2,2-dimethylheptane	128.2551
1072-05-5	2,6-dimethylheptane	128.2551
111-84-2	N-nonane	128.2551
16747-26-5	2,2,4-trimethylhexane	128.2551
16747-30-1	2,4,4-trimethylhexane	128.2551

Appendix D - Speciated VOC needed from EPAct testing
Updated to reflect all compounds requested 9-13-07 MGC

CAS	NAME	SPEC_MW
2213-23-2	2,4-dimethylheptane	128.2551
2216-30-0	2,5-dimethylheptane	128.2551
2216-33-3	3-methyloctane	128.2551
2216-34-4	4-methyloctane	128.2551
3074-71-3	2,3-dimethylheptane	128.2551
3221-61-2	2-methyloctane	128.2551
3522-94-9	2,2,5-trimethylhexane	128.2551
922-28-1	3,4-dimethylheptane	128.2551
926-82-9	3,5-dimethylheptane	128.2551
27133-93-3	Methylindane	132.20228
824-63-5	2-methylindan	132.20228
874-35-1	5-methylindan	132.20228
105-05-5	1,4-diethylbenzene (para)	134.21816
1074-17-5	1-Methyl-2-npropylbenzene	134.21816
1074-43-7	1-Methyl-3-propylbenzene	134.21816
135-98-8	(1-Methylpropyl)benzene	134.21816
141-93-5	1,3-diethylbenzene (meta)	134.21816
1758-88-9	1,4-dimethyl-2-ethylbenzene	134.21816
2870-04-4	1,3-dimethyl-2-ethylbenzene	134.21816
488-23-3	1,2,3,4-tetramethylbenzene	134.21816
527-53-7	1,2,3,5-tetramethylbenzene	134.21816
527-84-4	1-Methyl-2-isopropylbenzene	134.21816
535-77-3	1-Methyl-3-isopropylbenzene	134.21816
538-93-2	(2-methylpropyl)benzene	134.21816
874-41-9	1,3-dimethyl-4-ethylbenzene	134.21816
933-98-2	1,2-dimethyl-3-ethylbenzene	134.21816
934-74-7	1,3-dimethyl-5-ethylbenzene	134.21816
934-80-5	1,2-dimethyl-4-ethylbenzene	134.21816
95-93-2	1,2,4,5-tetramethylbenzene	134.21816
99-87-6	1-Methyl-4-isopropylbenzene	134.21816
1678-93-9	Butylcyclohexane	140.2658
26967-64-6	Methyl propylcyclohexanes	140.2658
124-18-5	N-decane	142.28168
14720-74-2	2,2,4-trimethylheptane	142.28168
15869-85-9	5-methylnonane	142.28168
15869-87-1	2,2-dimethyloctane	142.28168
15869-89-3	2,5-dimethyloctane	142.28168
15869-93-9	3,5-dimethyloctane	142.28168
15869-94-0	3,6-dimethyloctane	142.28168
20291-95-6	2,2,5-trimethylheptane	142.28168
2051-30-1	2,6-dimethyloctane	142.28168
4032-94-4	2,4-dimethyloctane	142.28168
4110-44-5	3,3-dimethyloctane	142.28168
5911-04-6	3-methylnonane	142.28168
7146-60-3	2,3-dimethyloctane	142.28168
871-83-0	2-methylnonane	142.28168
1074-92-6	t-1-Butyl-2-Methylbenzene	148.24474
1595-11-5	1-Methyl-2-n-butylbenzene	148.24474
16021-20-8	1-ethyl-2-npropylbenzene	148.24474
538-68-1	N-pentylbenzene	148.24474
821-95-4	1-undecene	154.29238
1120-21-4	N-undecane	156.30826
98-19-1	1-(1,1-dimethylethyl)-3,5-dimethylbenzene	162.27132
99-62-7	1,3-diisopropylbenzene	162.27132
112-40-3	N-dodecane	170.33484
39515-41-8	Danitol	349.42

APPENDIX B

COST DETAIL FOR WORK ASSIGNMENT 0-01

Ex. 4 - CBI

Ex. 4 - CBI

Attachment A

COST BREAKDOWN

Ex. 4 - CBI